SHC63-9015-103
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ITEK LABORATORIES
10 Maguire Road
Lexington 73, Massachusetts

8 March 1963

OXC-2648
COPY 2 OF 3

STAT

Processor Progress Report from 1 February to 1 March 1963

STAT

Flight Tests

Correlation of flight film S-37 continued into February with significant improvement over previous flights. The best output photos were obtained using a duplicate of the primary record, a technique which apparently provided a certain amount of signal enhancement. Figures 3, 4 and 5 are representative of the better correlated film. A set of corner reflectors of various radar cross sections and separations were placed in a parking lot of a stadium west of the Naval Academy at Annapolis (Fig. 3). Reflectors separated by 30 feet in azimuth were clearly resolved, and in range the resolution was also about 30 feet, but because of saturation or "overshoot" of the signal in the range direction the separation was not as pronounced. Two reflectors were separated by 25 feet in azimuth, but they appeared to have been lost in the strong return from the rest of the targets.

Figure 6 is a 7X enlargement of the primary record showing the stadium and corner reflector area. If the picture is viewed such that the figure number is on the left, the signal history of the reflectors can be seen in the center of the picture, with the zero beats occurring about 1 1/2 inches from the left hand edge of the picture area. The stadium is the U-shaped area above and to the right of the reflectors. It should be noted that the azimuth data is stretched-out approximately 8 3/4 times that in range.

Correlation of S-37, and subsequent films, was done with the 10 inch wedge interference filter for range compensation. Because of the altitutde of flight and range interval involved, there is a mismatch between the slope of the wedge and the range interval. This results in defocusing and degradation of the image toward the edges of the film. There is considerable improvement over monochromatic illumination, however.

Flight S-39 was flown at 40,000 feet, but because of corona near the CRT the entire film was covered with saw-toothed banding which occurred at a frequency of about 4 cps.

Flight film S-40 was received on 23 February 1963 and correlated. The second run was particularly good (Fig. 7), showing much of the more familiar areas of Washington, D.C. The runway approach lights or supporting structure at National Airport, projecting into the Potomac River are clearly seen, as are airplanes, vehicles or other structures on and around the runways. The detail in this film seemed even better than S-37. Unfortunately, the corner reflectors were not in the mapped area, so no direct comparison between S-40 and S-37 is possible.

Tests are now being conducted in an attempt to improve the dynamic range and the signal-to-noise ratio. Studies are being made concerning the effects of duplicating the primary record, the effects of the gamma or gamma product of the films, and the diffracting efficiency of various types of film.

Modifications

Camera: The camera unit was installed with a dial indicator, to facilitate thru focus runs. It has proved most helpful in tracing some of the stray light problems. The camera together with monobath processing have enabled us to proceed very quickly with many preliminary tasks.

Television: The fabrication of the mount for the television camera is 90% complete. It will be mounted during the second week of March.

Drive Study: Several transport runs were made to determine the stability and repeatability of the drive system. It was found that the change of insertion and tilt necessary was beyond the capability of the detectors and wear on the eccentric cam for the fine adjustment made accurate settings impractical. New parts were fabricated.

Several new systems were studied to give continuous control over a speed range of 1000:1.

Platen: The mechanical parts for the new platens are complete. The glass platens will be ready for mounting early in March.

Performance Studies

Range Resolution: New long line resolution targets of 24, 32, 40, 66, 88, 110 lines per millimeter were made up. These were used in conjunction with the camera and best resolution obtained was 88 lines per millimeter at the input. Since in the application only 40 lines per millimeter will be used most of the work done was to increase the contrast at this level. Figure 1 is a 40X enlargement of the results. The first run on the roller platen was overexposed and will be rerun during the early part of March. Table I outlines the tests made.

Azimuth Resolution: The camera was also used to obtain the best correlation of the ruled target. A mercury arc source was used to limit the bandwidth. Best preliminary results gave a line width of .002. Figure 2 is a 40X enlargement of this image.

Sincerely,

STAT

CWM/bh

TABLE I

Range Resolution

Target	Output Film	Mode	Purpose	Resolution at output (1/mm)	Comments
T20	Polaroid	Camera	Focus	20	approaching limit of film
T20C1-6	Panatomic X	Camera	Focus	33	35μ slit
T20C7-12	Panatomic X	Camera	Focus	33	35μ slit, zero stop removed under exposed
T20C13-24	Panatomic X	Camera	Focus	44	35μ slit. 2 best focus.
T20C25-30	Panatomic X	Camera	Exposure	--	1/5 sec best 35μ slit
T20C31-42	Panatomic X	Camera	Focus	44	35μ slit
T21C1-6	Panatomic X	Camera	Focus	20	Best focus difficult to identify
T21C7-16	SO243	Normal	Exposure	--	monobath development
T21C17-36	SO243	Normal	Focus	20	Over-exposed — developed in D76.

Azimuth Resolution				Line Width	
T215C8-13	Panatomic X	Camera	Exposure	---	15μ slit.
T215C14-19	Panatomic X	Camera	Focus	.0024	15μ slit.
T215C20-26	Panatomic X	Camera	Exposure	---	Hg arc source 6μ slit.
T215C27-38	Panatomic X	Camera	Focus	.0020	Hg arc source 6μ slit.

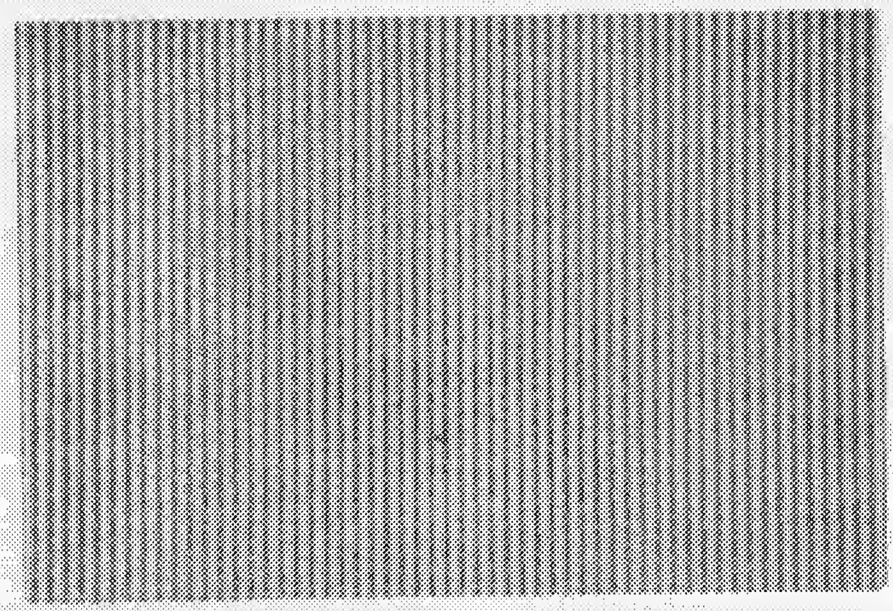

Image Obtained in Range Resolution Test

Figure 1

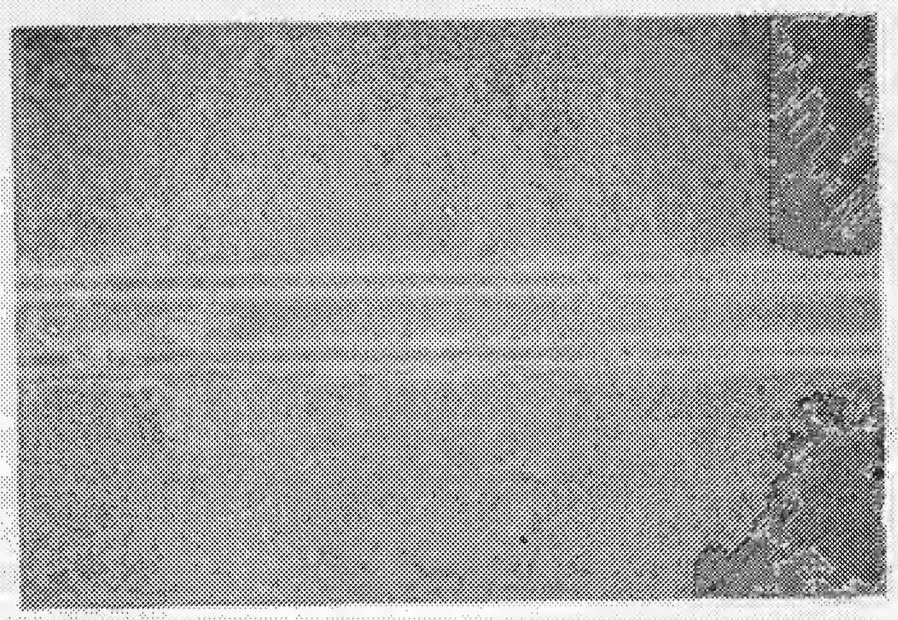

Image Obtained in Azimuth Resolution Test

Figure 2

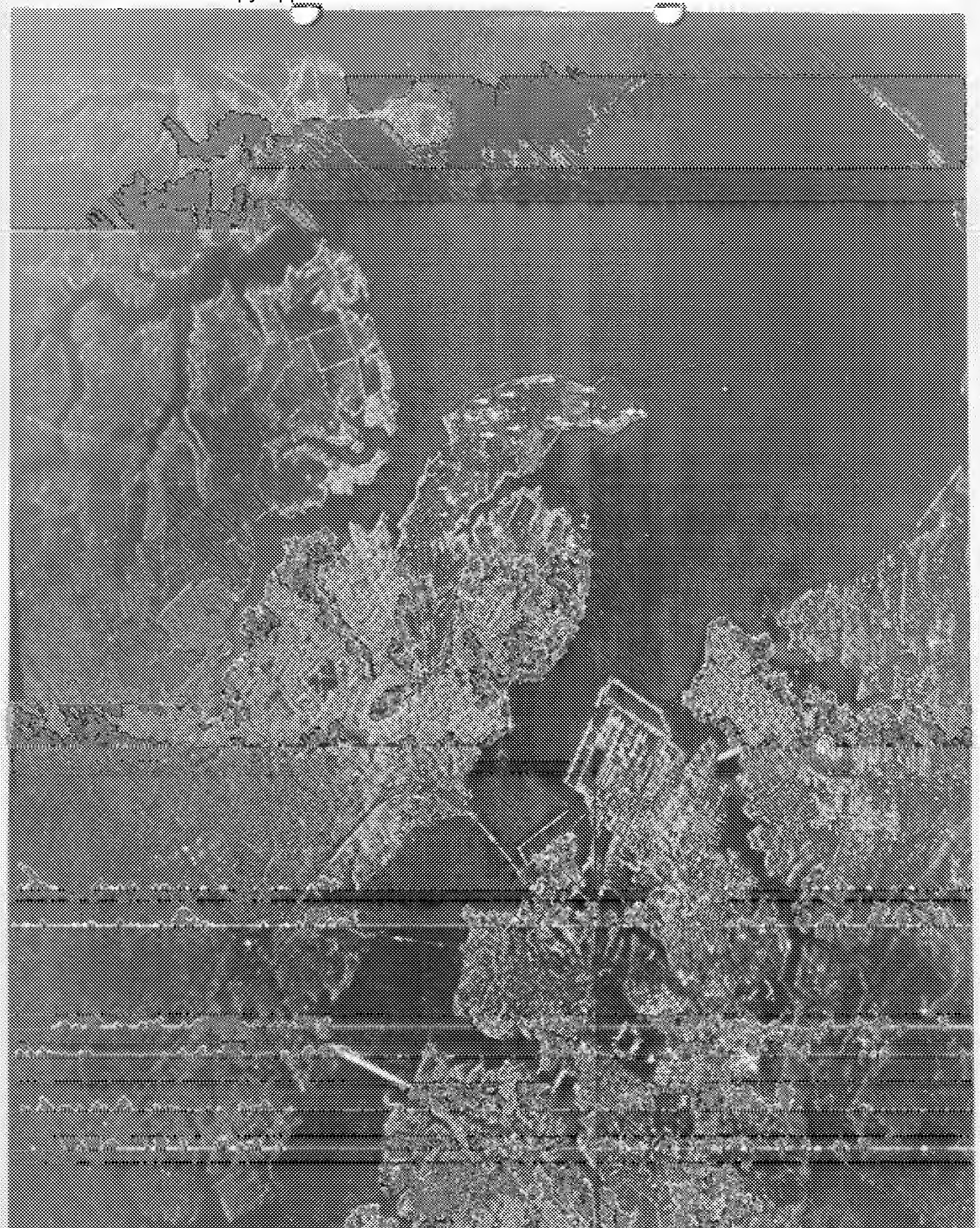

Figure 3

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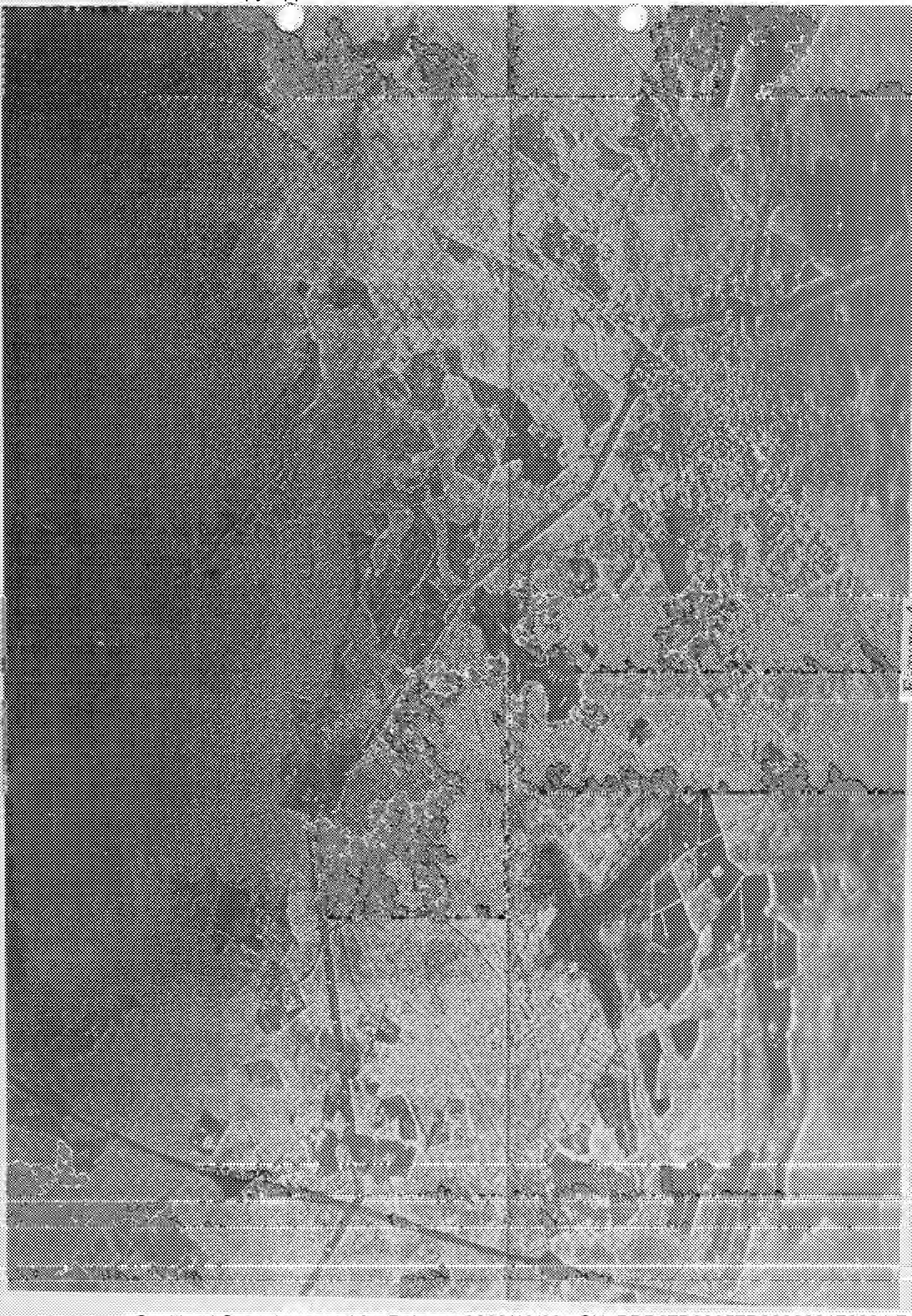

Figure 4

Figure 5

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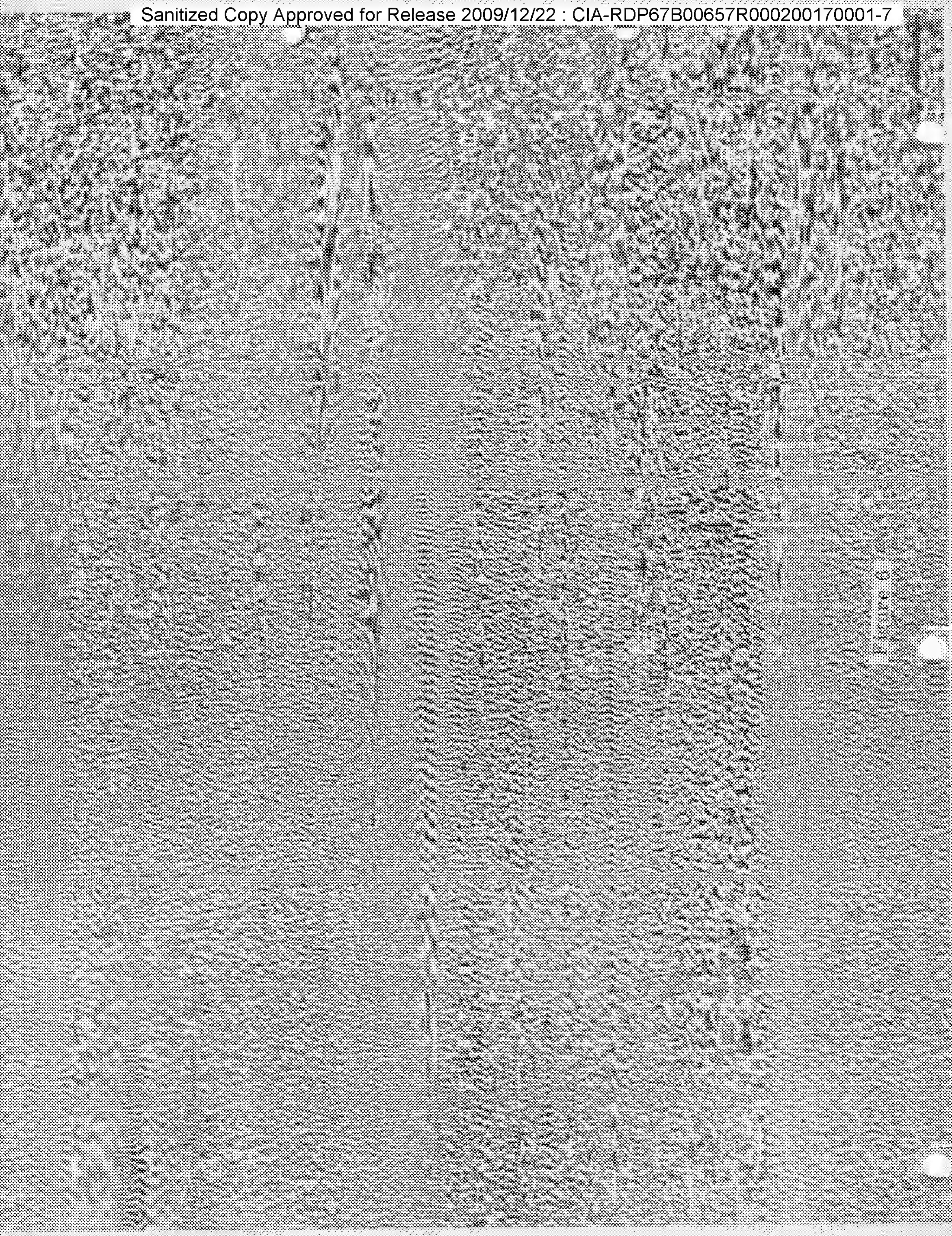

Figure 6

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Figure 7

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ITEK LABORATORIES
10 Maguire Road
Lexington 73, Massachusetts

OXC-4913
COPY 2 OF 3

15 April 1963

STAT

Processor Progress Report from 1 March to 1 April 1963

INTRODUCTION

Much of the effort during March was oriented toward determining the present capability of the processor and obtaining the best results from it. The later part of the month was devoted in part to the planning of the future of the program, especially the equipment and facilities required to support the advanced flight test program this Fall. The processor and a proposed small general purpose test bench will be installed and operated at the testing site.

PROCESSOR MODIFICATIONS

Television: The TV camera was installed with a temporary mount to check on interferences and operational problems. The base for the optical train interferred with the pedestal for the camera, and each unit will require modification for permanent use. These modifications are in progress.

Drive Study: A test fixture was constructed and used to determine the action of the rubber drive wheels (see Fig. 1). It was found that the drive ratio depends on the depth of insertion in a strange fashion; namely, the speed of the driven rubber wheel decreases as the metal driver wheel is inserted deeper. The action is dependent upon the manner in which the tire deforms, causing the portion of the tire which is in contact to move faster than a radius line on the hub of the wheel as is shown in Fig. 2.

The action was found to be dependable and repeated to good accuracy. The speed ratio does depend on the amount of torque transferred, but this change is constant with constant torque and is very small for the torque (6 inch-oz) required to drive film.

A new drive unit using one rubber tired wheel and two metal wheels is being designed. The motor drive, mounts, and controls will be much improved.

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Dust Control: The dust protection covers around the optical system has progressed through a number of designs in cardboard and cloth. The present arrangement is working fairly well, and it will now be made permanent. The most difficult area (near the ouput slit) will not be covered at present since it is not a serious dust area and it is very congested with hardware and adjustments.

Anachromatic Wedge: It had been Mr. Worthington's suggestion to use a wedge or prism with a controlled dispersion to partially eliminate the resolution loss due to lateral color shift of the image. This development was investigated briefly and shelved in favor of the cone lens study. However, recent information and experience has indicated that the cone lens cannot be engineered into the system quickly, so the anachromatic wedge has been re-activated. If it is feasible, it will be built into the processor.

Zero Order Stop: The new relay lens cell with the improved zero order stop is fabricated and assembled. Photographs of the assembly are shown in Figs. 3 and 4. Most interior surfaces are yet to be painted with special optical flat black enamel. The stop edges will be gloss black to reflect the strong zero order into the light baffle system. The complete lens will then be installed.

Platen: The glass flats were fabricated in March. The specifications call for a high efficiency multi-layer anti-reflection coating. This will have to be done elsewhere, and it appears that all presently available techniques produce undesirably soft coatings. This presents a quandry which will be resolved during the first week in April so that the platen can be completed and installed by the end of the month.

TEST PROGRAM

Report: A report describing the work done on the test and simulation program (Itek subproject 9015.12) has been completed and will be published in April.

Cylinder Lens Ray Trace: A computer program, to determine the expected performance of the cylinder lens optical system, has been started. This will utilize the newly available skewray program for non-symmetrical (i.e. cylinder lens) optical systems and will give more accurate data.

Target Testing: The azimuth tests indicated early in the month that the test targets are not perfect. Some new targets were being made and became available for checking late in the month. Two methods

were developed to check the targets, each one difficult. A method based upon distance measurement of certain lines is being pursued.

Point Image Tests: In order to determine that flight film correlations are being processed to the maximum capability of the unit, a series of tests were made using dot patterns. These patterns, shown in Fig. 5, are approximately .001 inches wide and are enlarged 2X. The exposures were made statically using the 4 x 5 camera in the processor with Polaroid 200 film. The resultant images were measued as .0025 inches wide in the range direction and are shown in Fig. 6.

The azimuth spot size was .0035 inches for a medium density pattern. Higher density patterns gave a longer image There was no evidence of "tailing" on a very heavy exposure as had been found on some of the flight film. Visual adjusting of the cylinder lens and focus did not cause this defect to appear.

FLIGHT TEST

Flight film S-41 was received and processed on March 5, 1963. The flight was at 20,000 feet in heavy clouds and haze. The radar observer reported RF failure indication throughout the run, although video was present on the cockpit scope. Examination of the primary record (Figure 7) showed that this failure did occur, resulting in the transmission and recording of a very wide pulse, degrading the range resolution by a factor of 20 or more. The far range was correlated and as expected displayed very poor range resolution (Fig. 8). Overall signal strength appeared to be more than adequate, with moderately good azimuth resolution.

Both flight films S-42 and S-43 were received and processed on March 8, 1963. Because of poor signal quality due to RF failure, S-42 (Fig. 9) was only examined visually in the correlator. This was the first flight at 40,000 feet.

S-43 (Fig. 10), which was flown at 20,000 feet, was correlated with fair to good results. For 30 seconds during the first run a 9 db attenuator was used to simulate the signal strength at the high altitude. Signal strength appeared to be adequate. Fig. 11 shows a comparison of adjacent areas with and without the attenuator. The attenuated section is the left hand or darker portion of the picture. On the original negative, of course, this area was lighter.

S-44 was the second 40,000 foot flight, but with the exception of a very few isolated areas (Fig. 12) did not contain any useful signals. The few correlated images that existed were examined visually. There was an excessive amount of noise structure at 180, 280, 320, 400, 500 and 550 cps. Since the two halves of the primary record showed somewhat

different noise structure, it is believed that the cause is due to vibration in the recorder. The 180 cps noise corresponds fairly closely to the aircraft engine speed and with the addition of after-burners for supersonic flight at this altitude there was probably considerably more buffeting than at the lower altitudes. It is not entirely inconceivable that the differential noise structure was due to electromagnetic deflection of the CRT trace, but this appears to be unlikely.

S-45, received and processed on March 15, 1963, was also at 40,000 feet. For the first $2\frac{1}{4}$ minutes of data film, where there were targets, the patterns were generally forward squinting. This was the region where either no tracking was established or the offset frequency was zero. The squint angle during the remainder of the run was swinging back and forth, somewhat more to the rear. Signal strength appeared to be adequate on the primary film (Fig. 13) and banding, while considerable, did not appear to be as severe as on S-44. The correlated film was not particularly good, with very low contrast, poor resolution and excessive banding (Fig. 14). The terrain mapped was mostly farmland with few structures or strong targets. With the antenna not very well stabilized the resolution predictably is rather low.

S-46, flown at 40,000 feet, had some very strong patterns, and in general was fairly good in overall signal strength (Fig. 15). However, the pulse width apparently varied throughout the run, since the patterns were modulated in the range direction — expanding and contracting as the hologram was generated.

The first correlated film (Fig. 16) was generally low contrast and suffered the same kind of banding evident on S-45. The correlated aerial image, found by the S-46 duplicate film, was examined in the camera attachment, and appeared to be quite good, particularly in the region of northern Baltimore. Films run using the duplicate primary record have been generally underexposed because of an excessively narrow setting of the spatial filter pass band. At this writing, the experiment is to be repeated with a better filter setting.

The next flight, S-47, was again flown at high altitude. Signal strength was fair, but targets appear and fade along the film. The mapping area again was mostly rural terrain. The correlated film (Fig. 17), like the primary film (Fig. 18), showed very strong banding, particularly on the near range half. There appeared to be at least two sources of this banding — vibration, which tends to be quite periodic, and the offset frequency which varies throughout the run. The offset frequency appears in the short turn-around part of the beginning of the CRT trace. This intensity modulation at the CRT causes a corresponding density variation across the entire width of the film. Superimposed on this offset frequency, which "bleeds through", are the vibration frequencies and any other noise frequencies.

Since the images created by the patterns lie in a plane quite close to the power spectrum of the patterns, it was felt that the correlator optics were producing an out-of-focus image of the spectrum or diffraction plane. It was found that by blocking off the vibration noise spike in the diffraction pattern either by suitable adjustment with the spatial filter, or by inserting a thin needle to occlude the spike, the banding could be considerably reduced. The needle used in the experiment was somewhat larger than required and blocked off useful frequencies as well, but this can be minimized. The banding which remained appeared to be caused by other sources such as the offset and electronic jitter of the trace.

S-48 (Fig. 19) received and processed on March 23, 1963, appeared to be characteristic of other high altitude flights with a number of very strong targets, while the weaker signals were very weak. Overall, the general picture (Fig. 20) quality is probably the best to date at high altitude, although S-46 had isolated areas where the resolution was somewhat better.

Sincerely,

[redacted]

STAT

CWM/bh

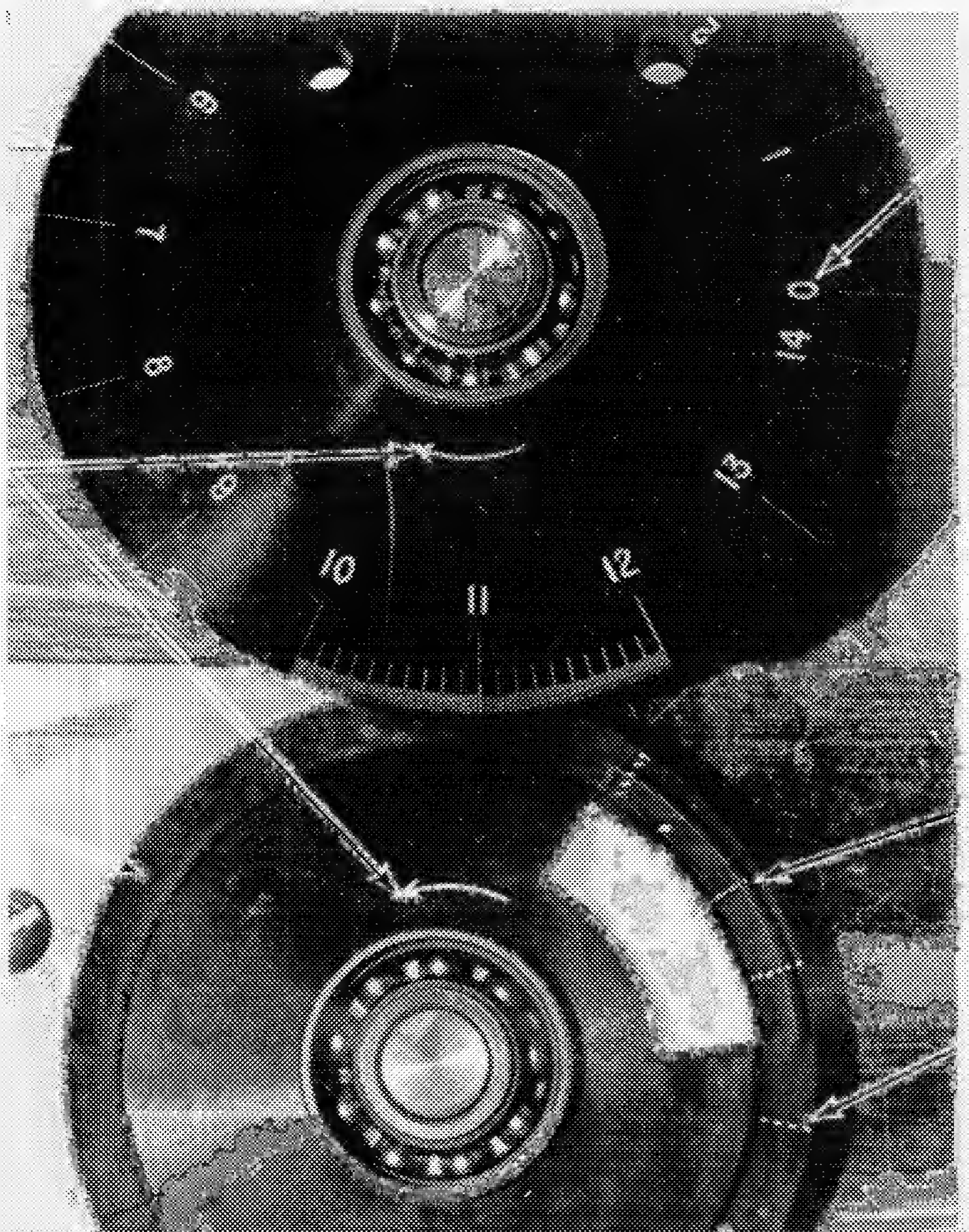


Fig. 1 — Rubber wheel drive test fixture

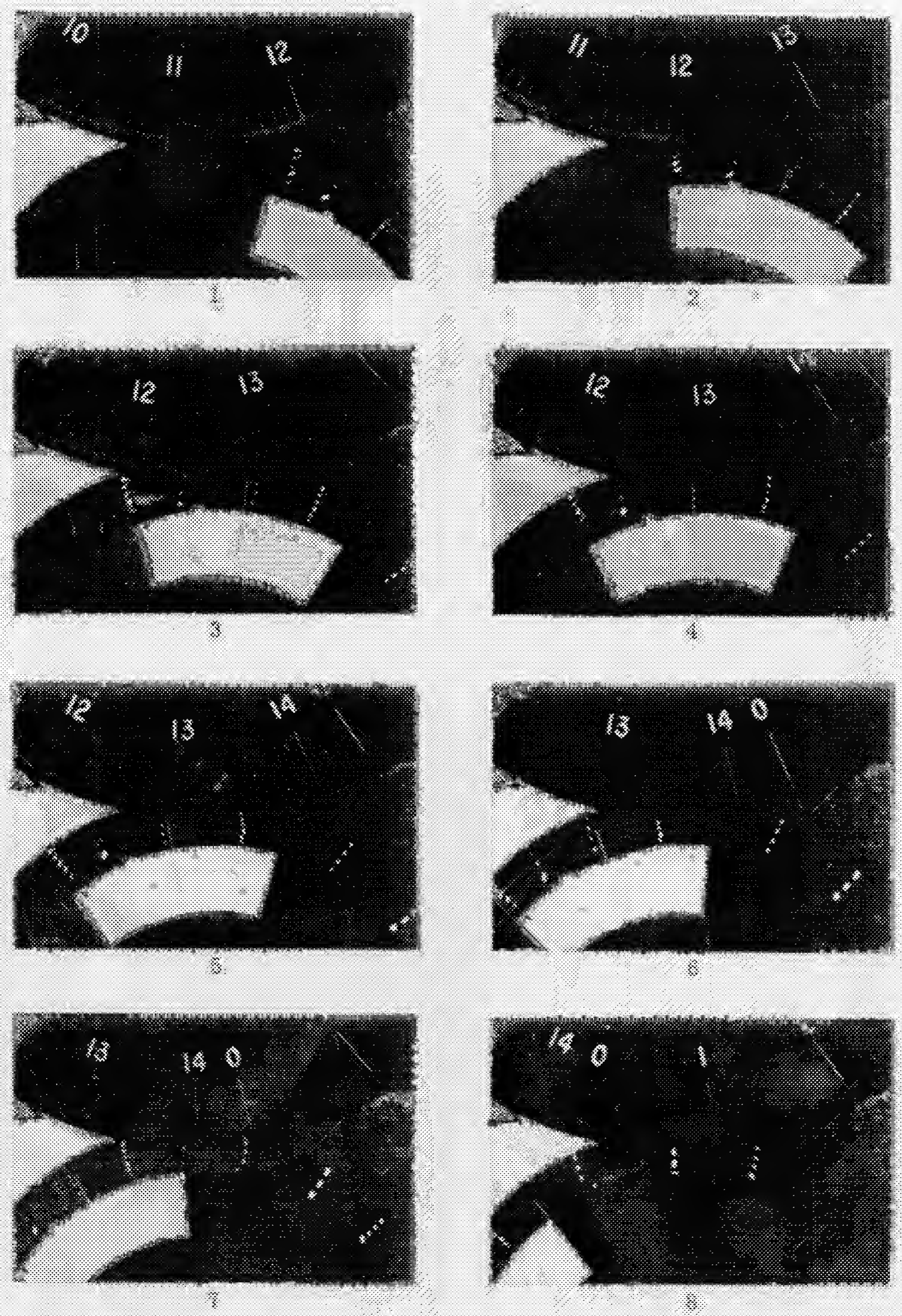
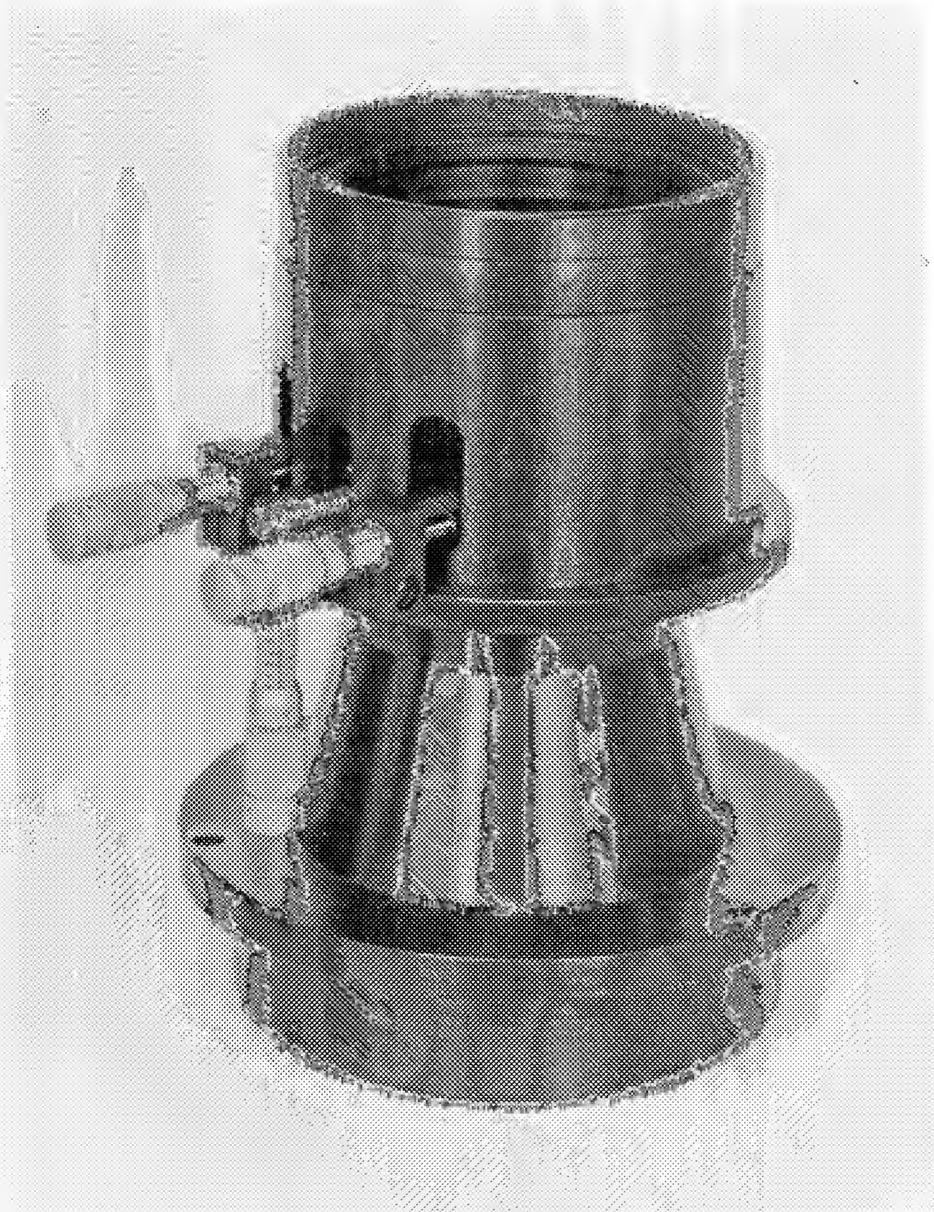


Fig. 2 — Rolling rubber tire

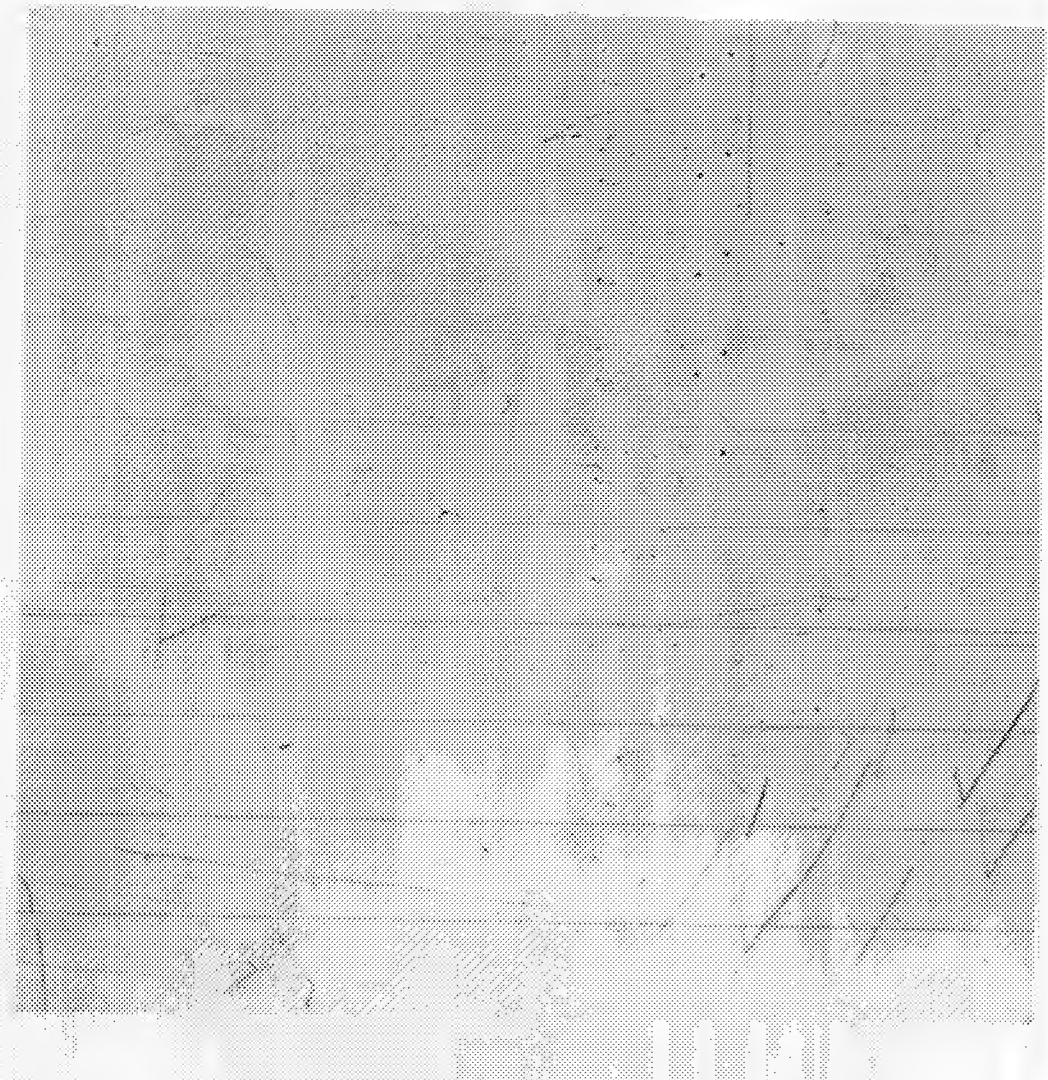


New Relay Lens Cell with Fine Adjustment
Micrometers

Figure 3

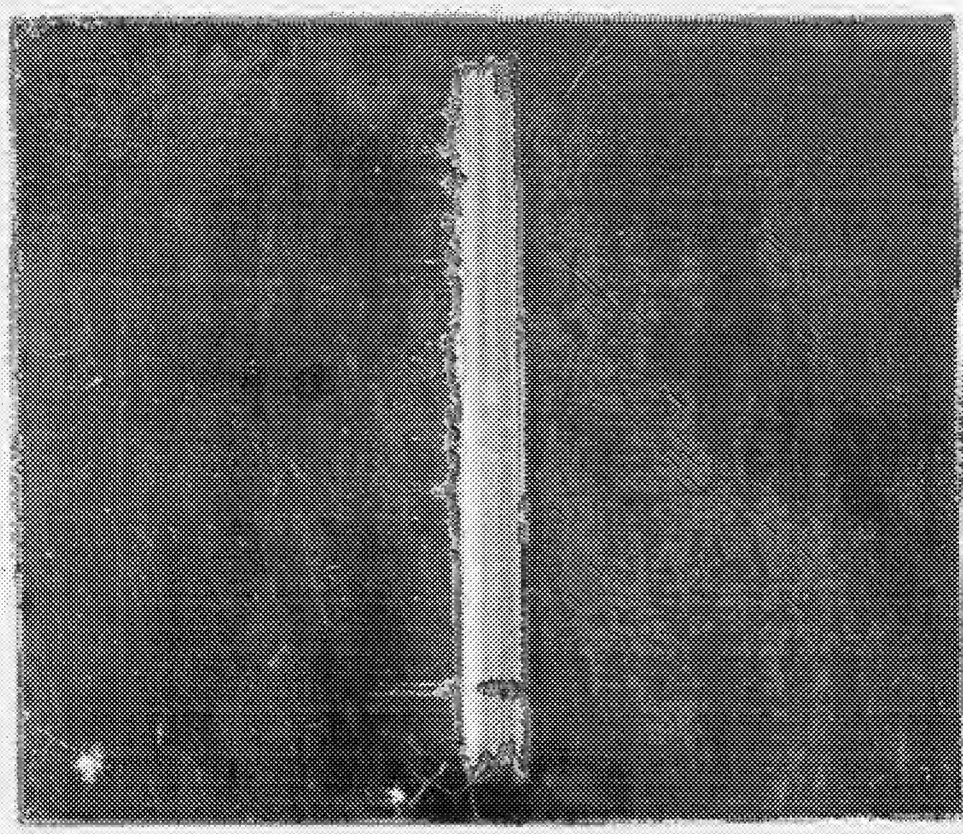
Top View Relay Lens Cell Showing Adjustable
Zero Stop Blades

Figure 4



Dot Patterns (5X) of Varying Density

Figure 5



Images of Dot Patterns (2X)

Figure 6

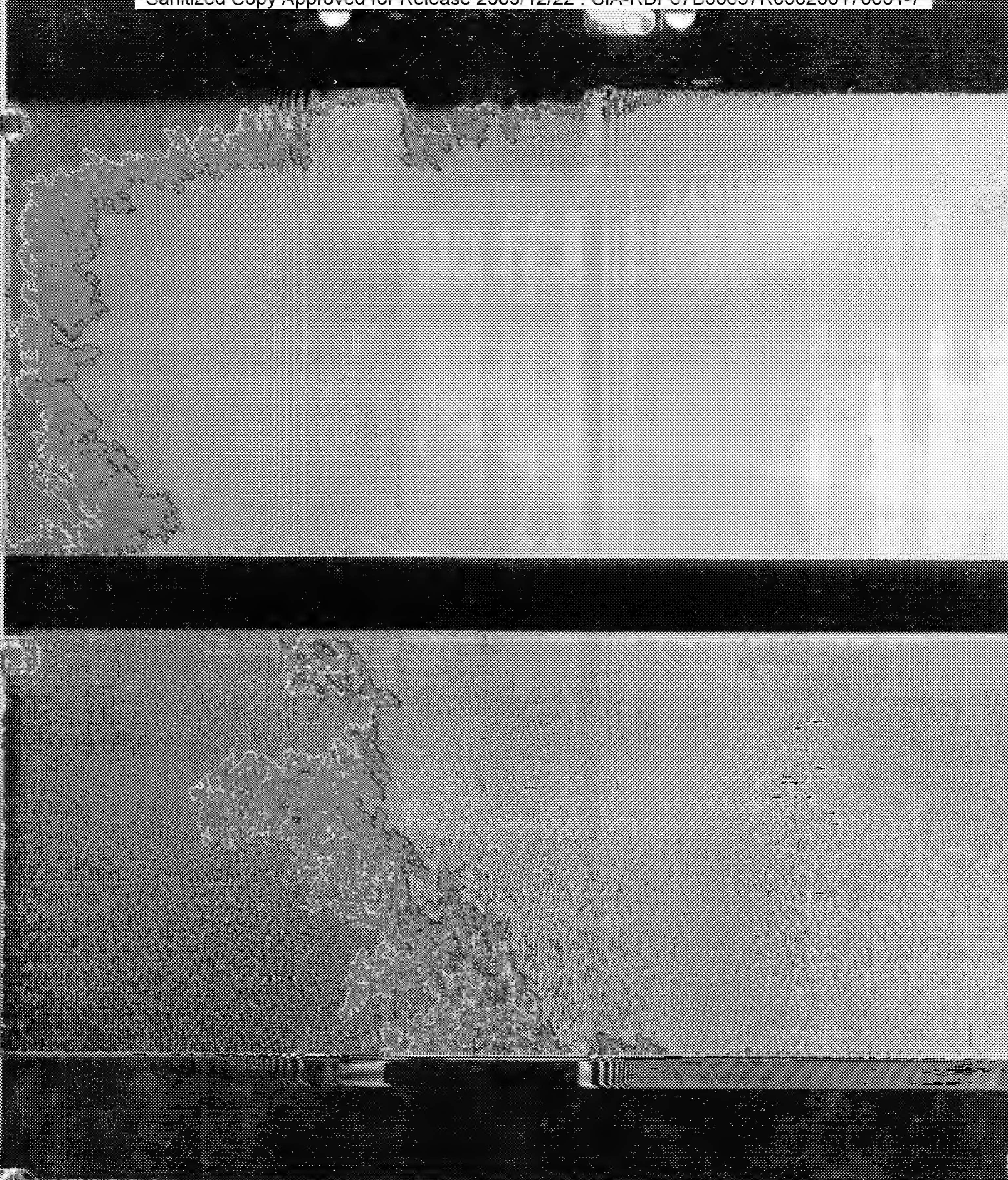


Figure 7

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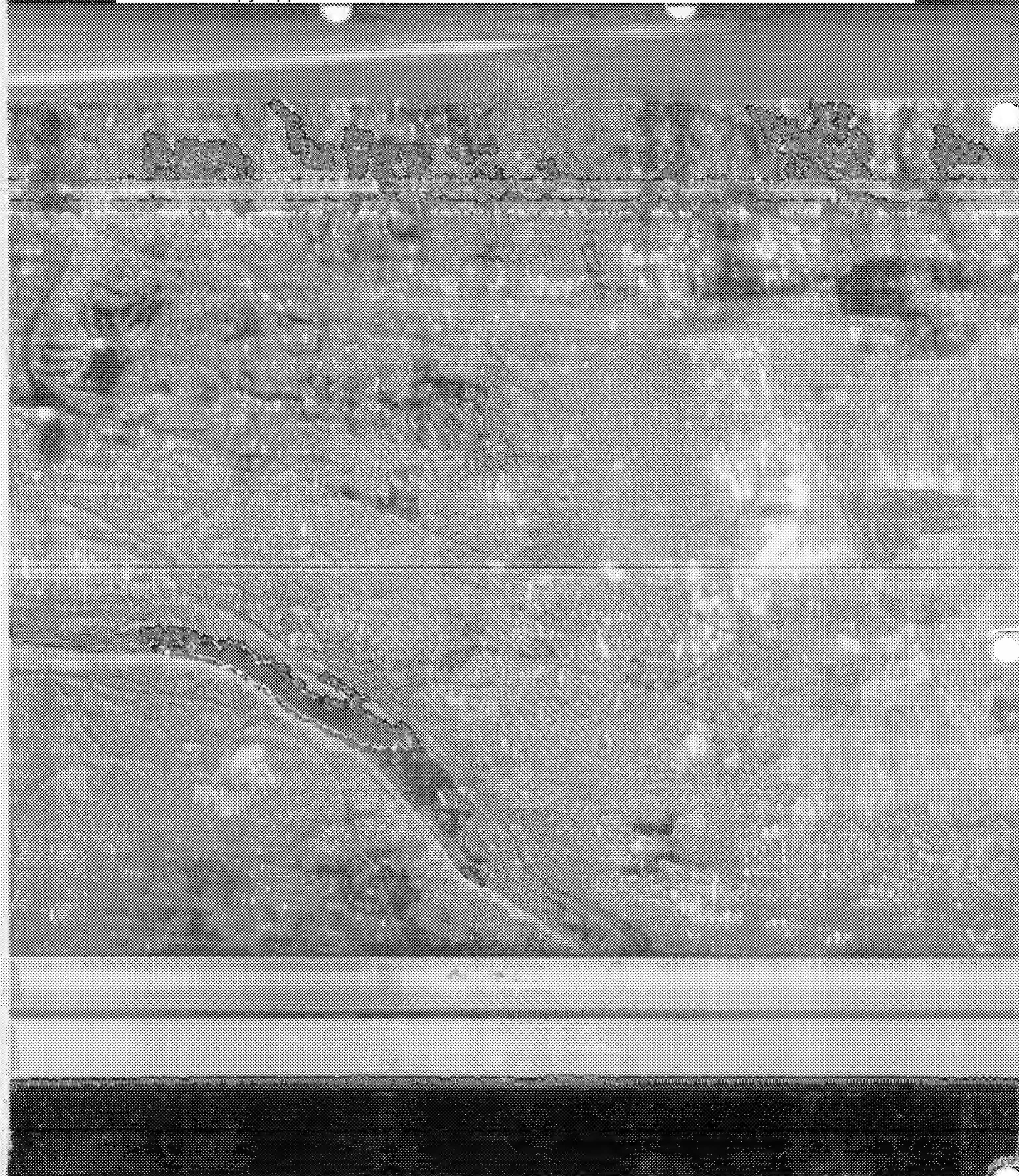

Figure 8

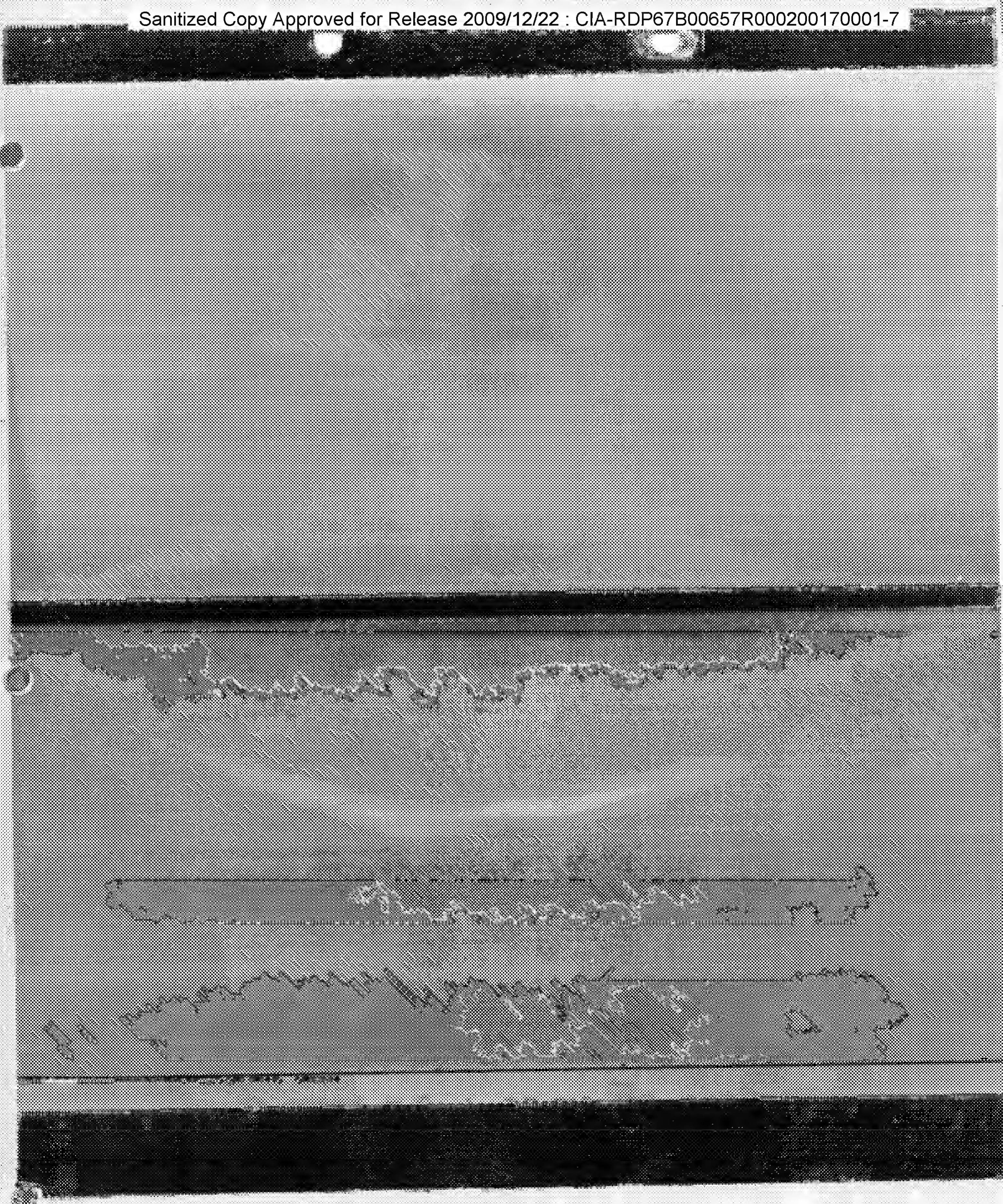

Figure 9

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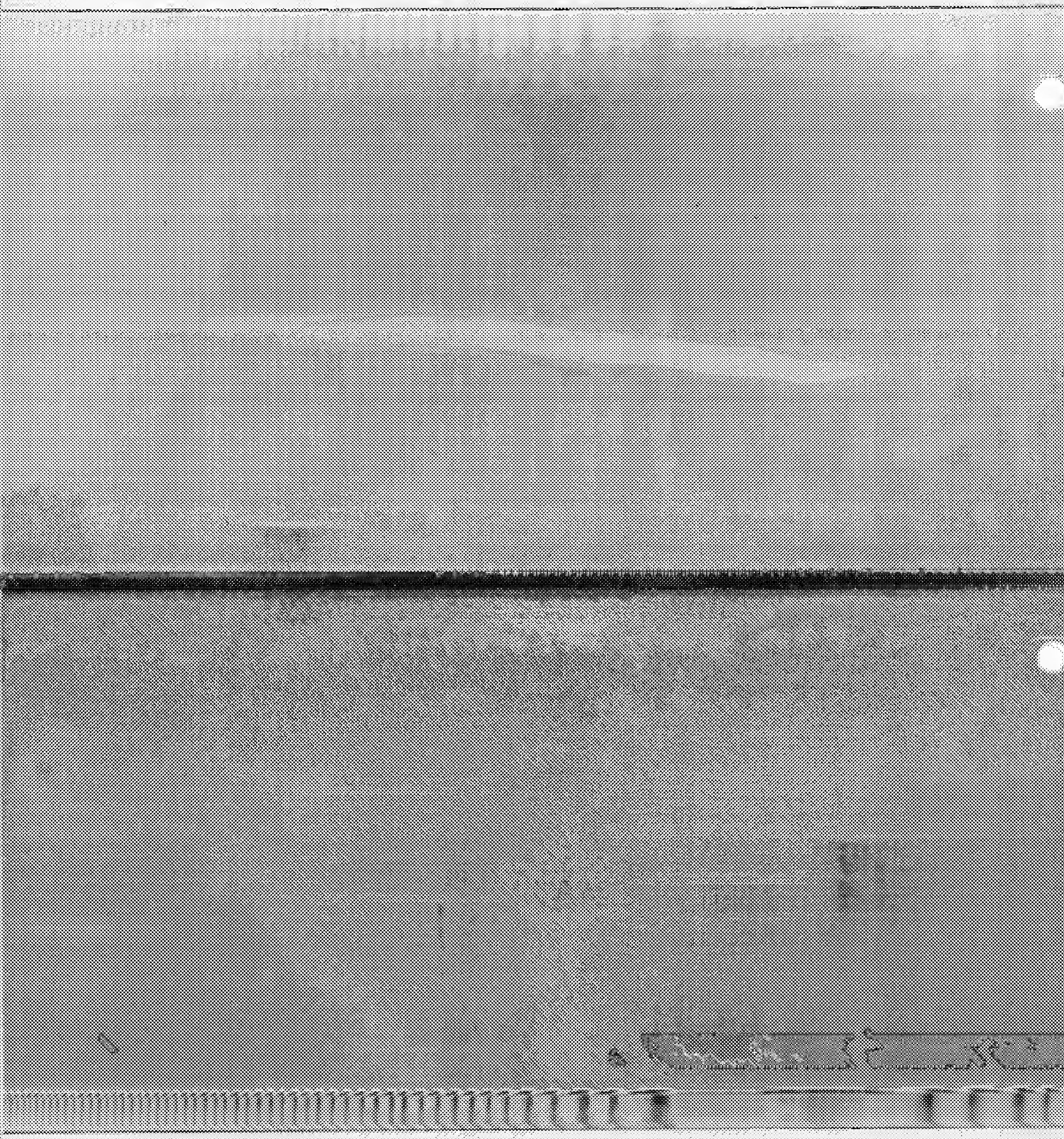

Figure 10

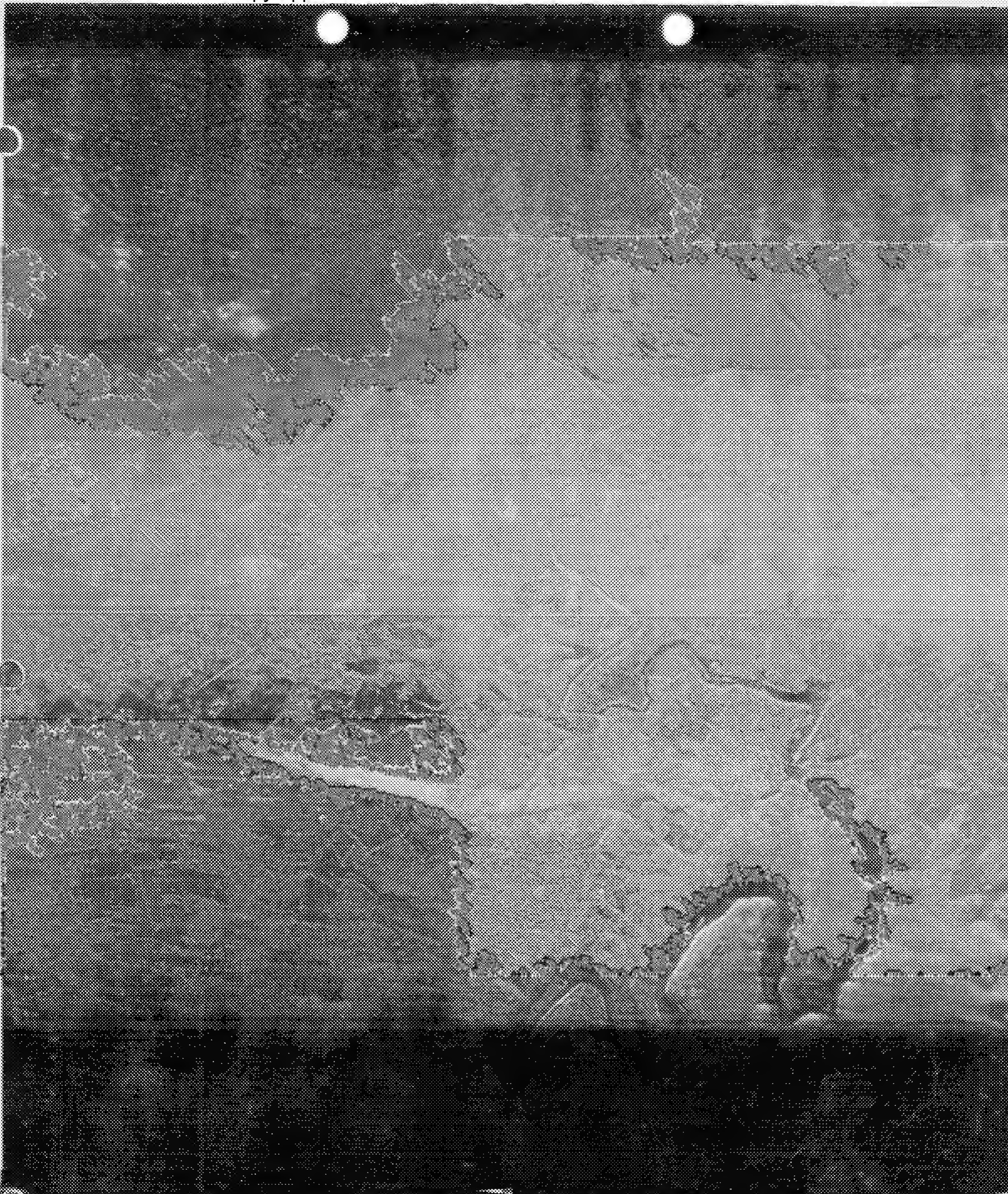

Figure 11

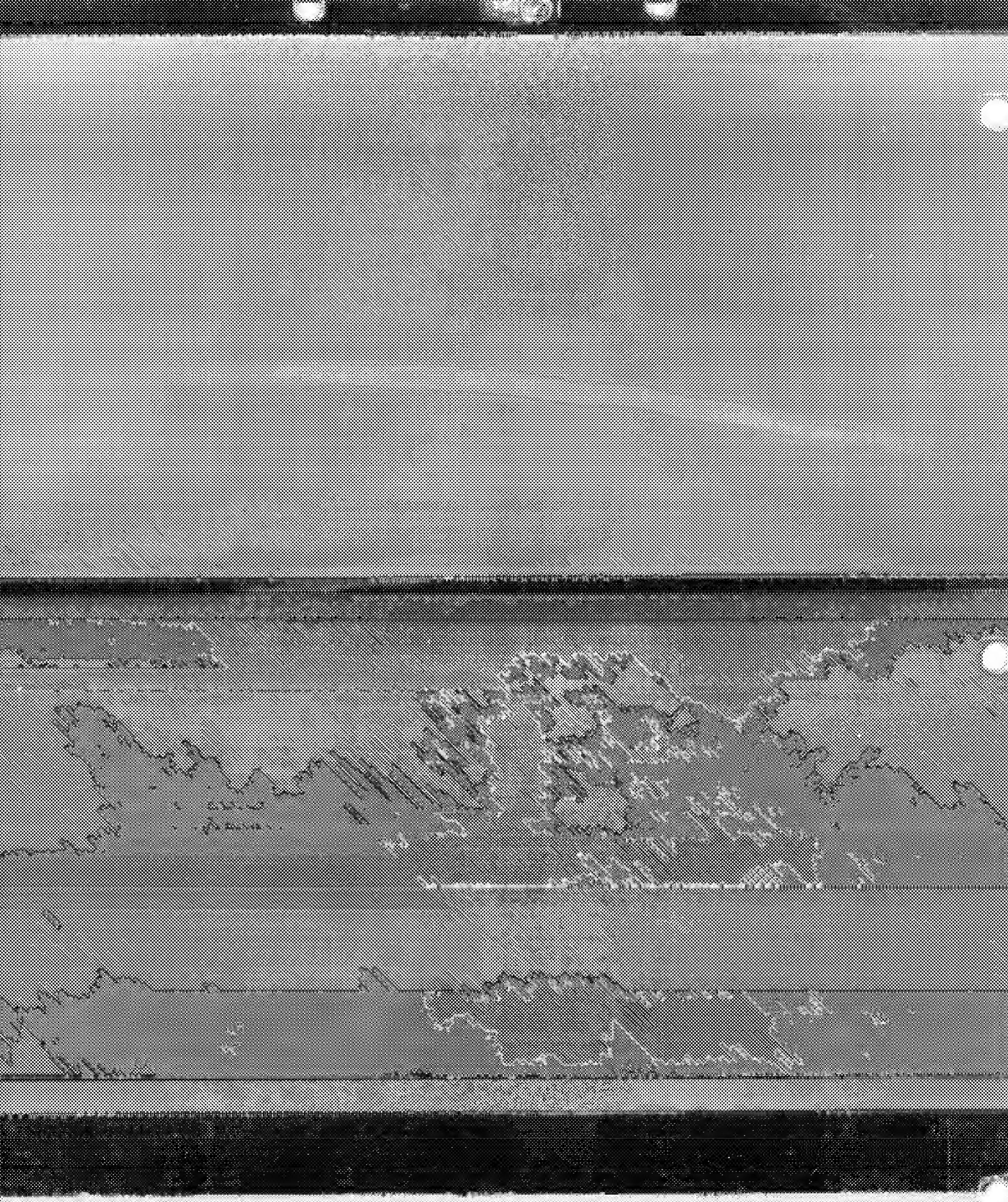

Figure 12

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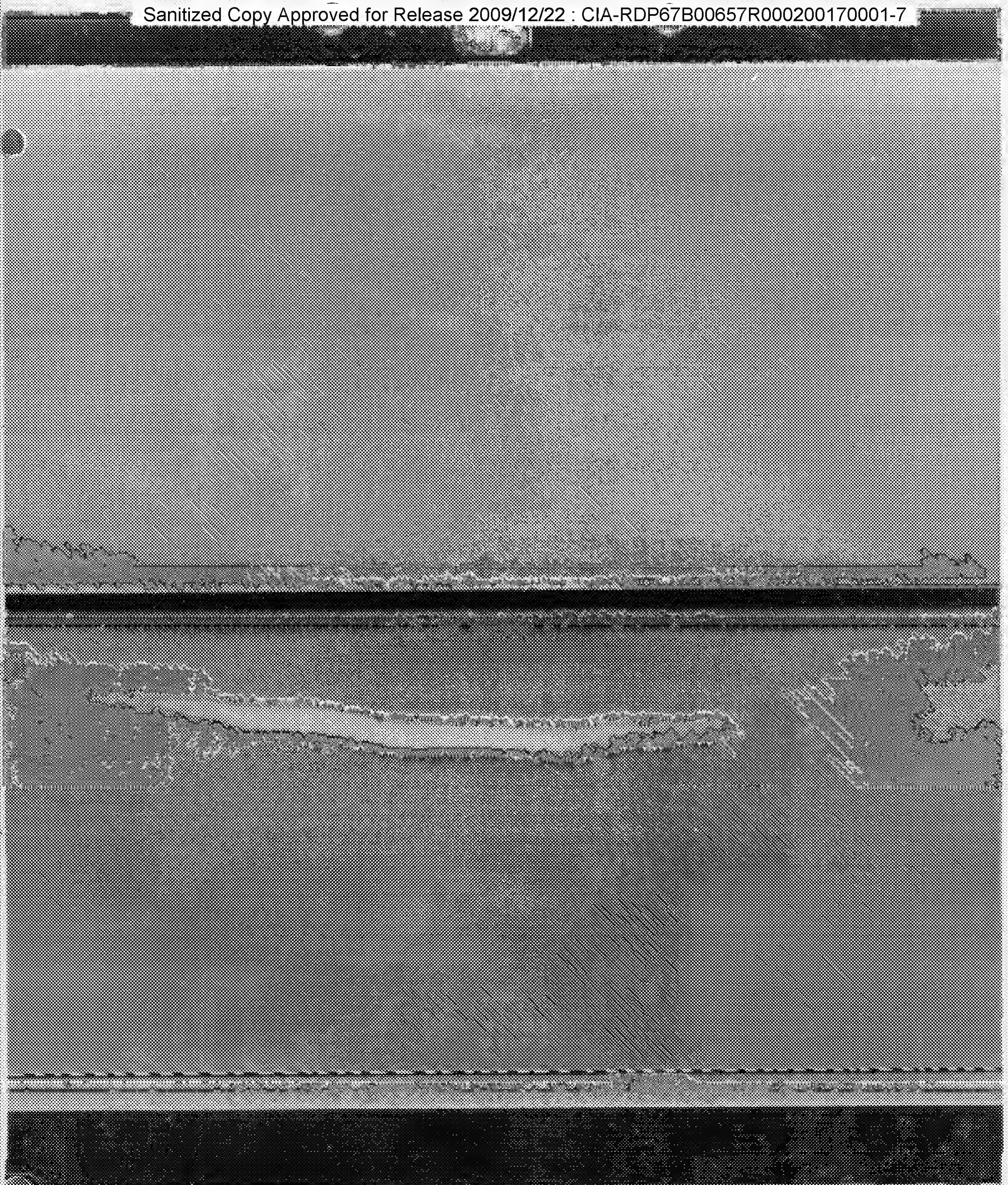

Figure 13

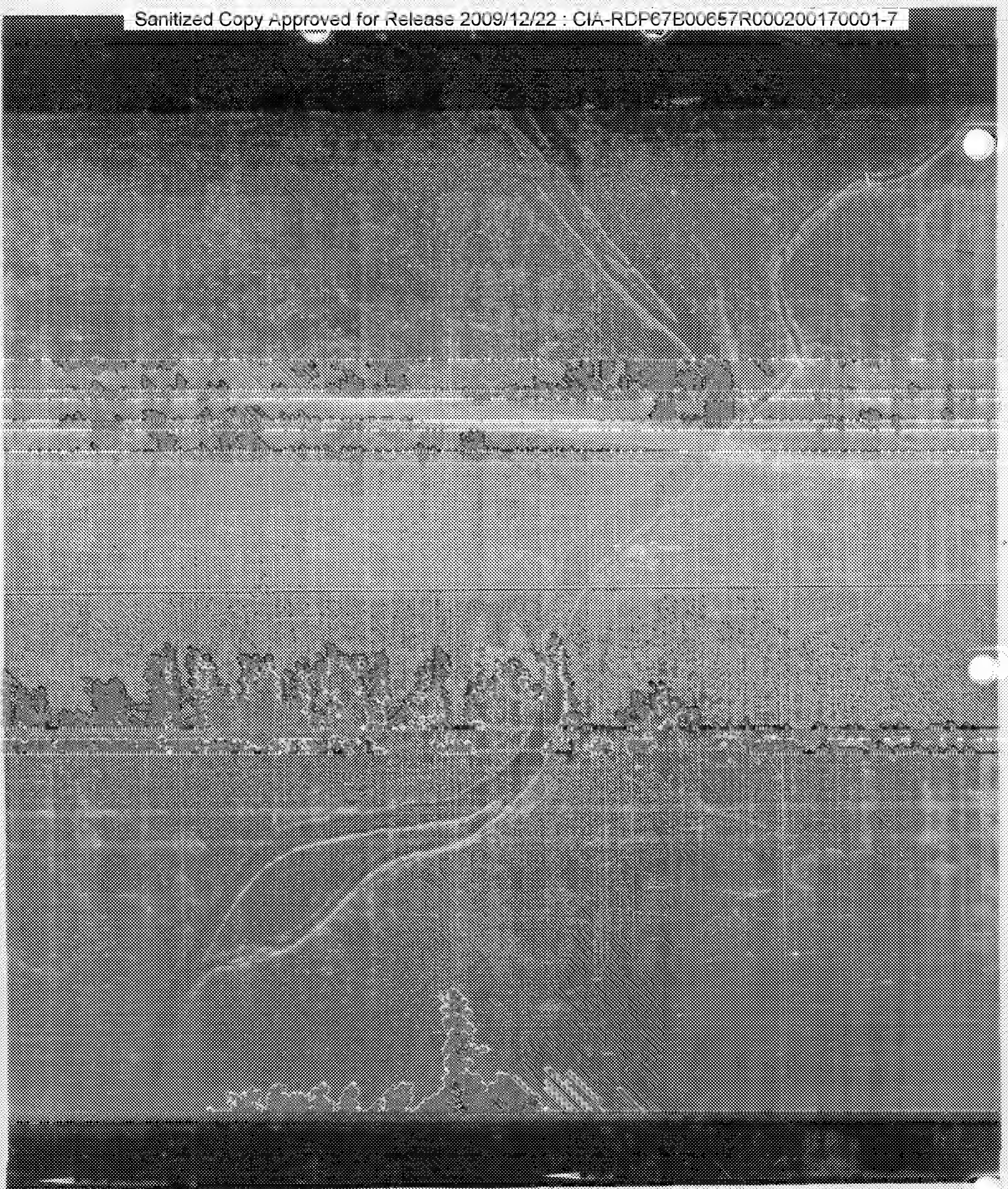

Figure 14

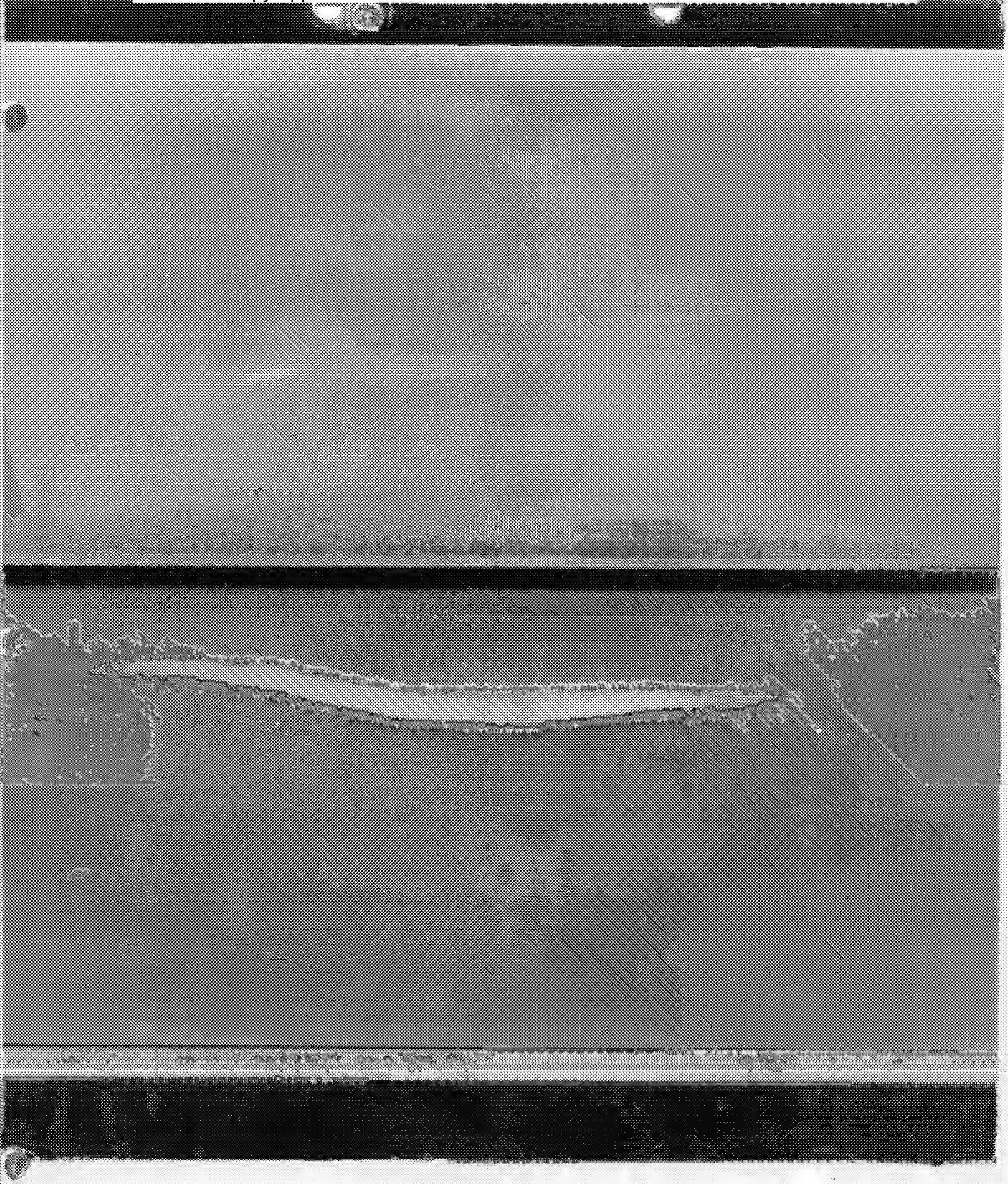

Figure 15

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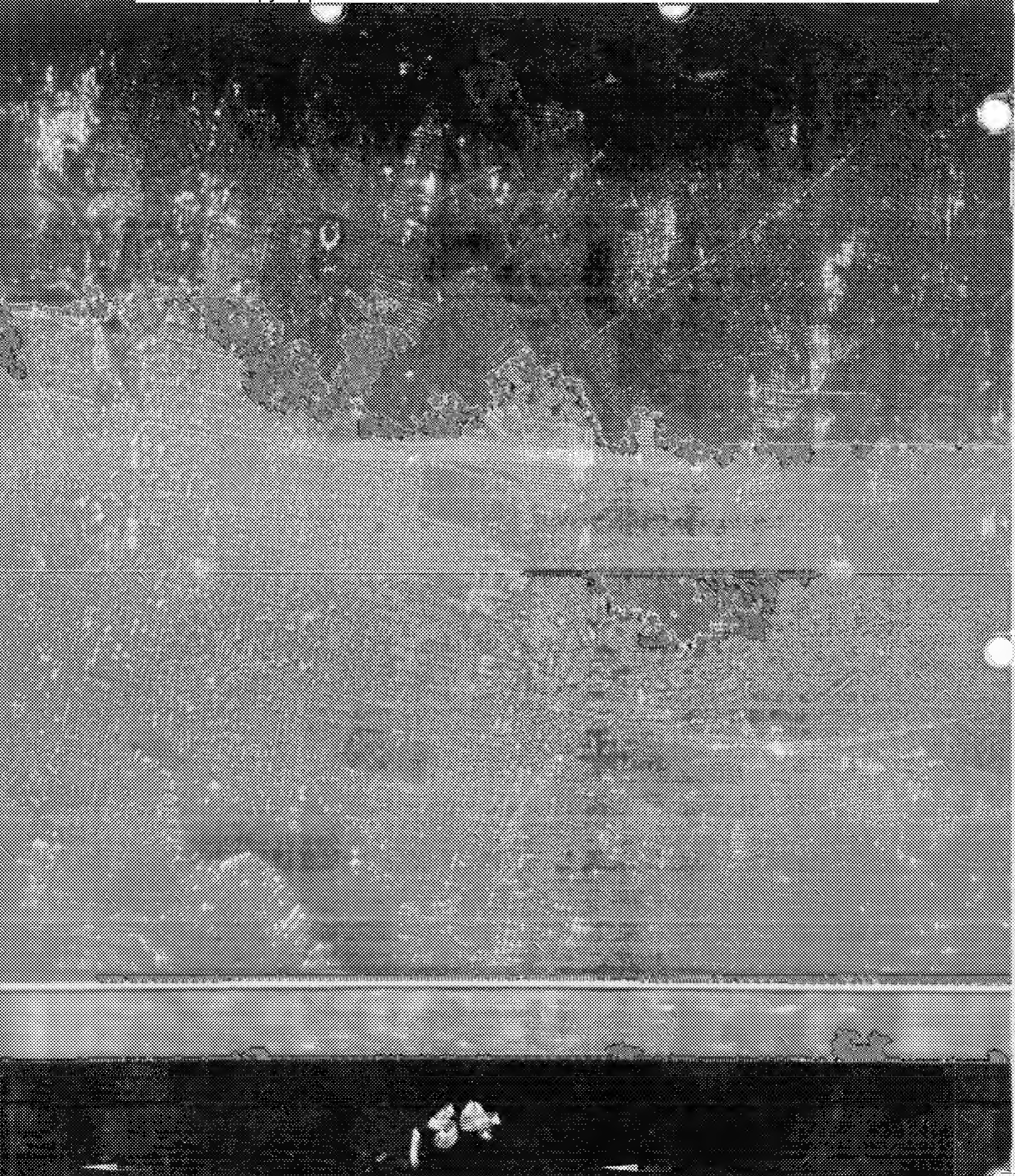

Figure 16

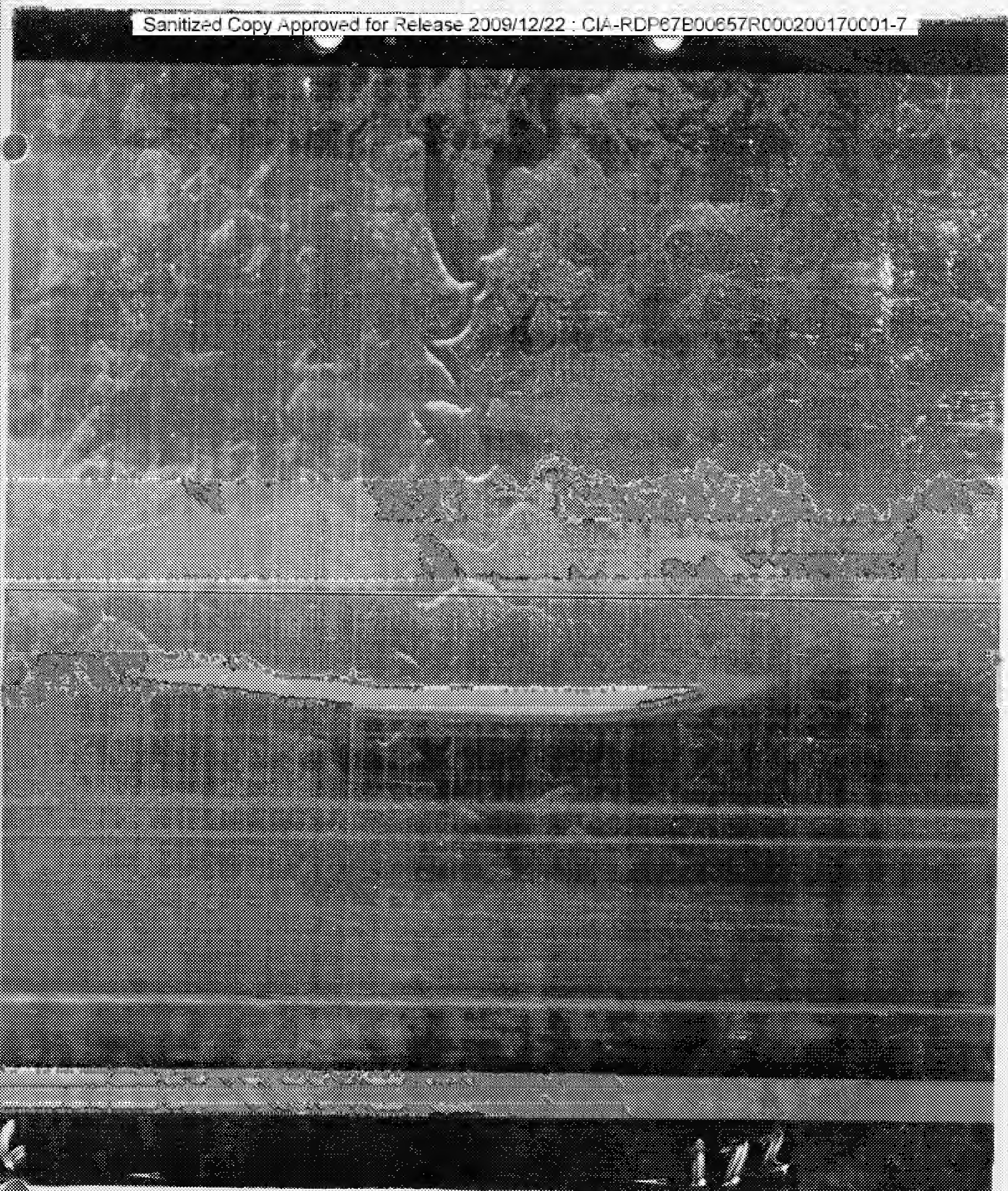

Figure 17

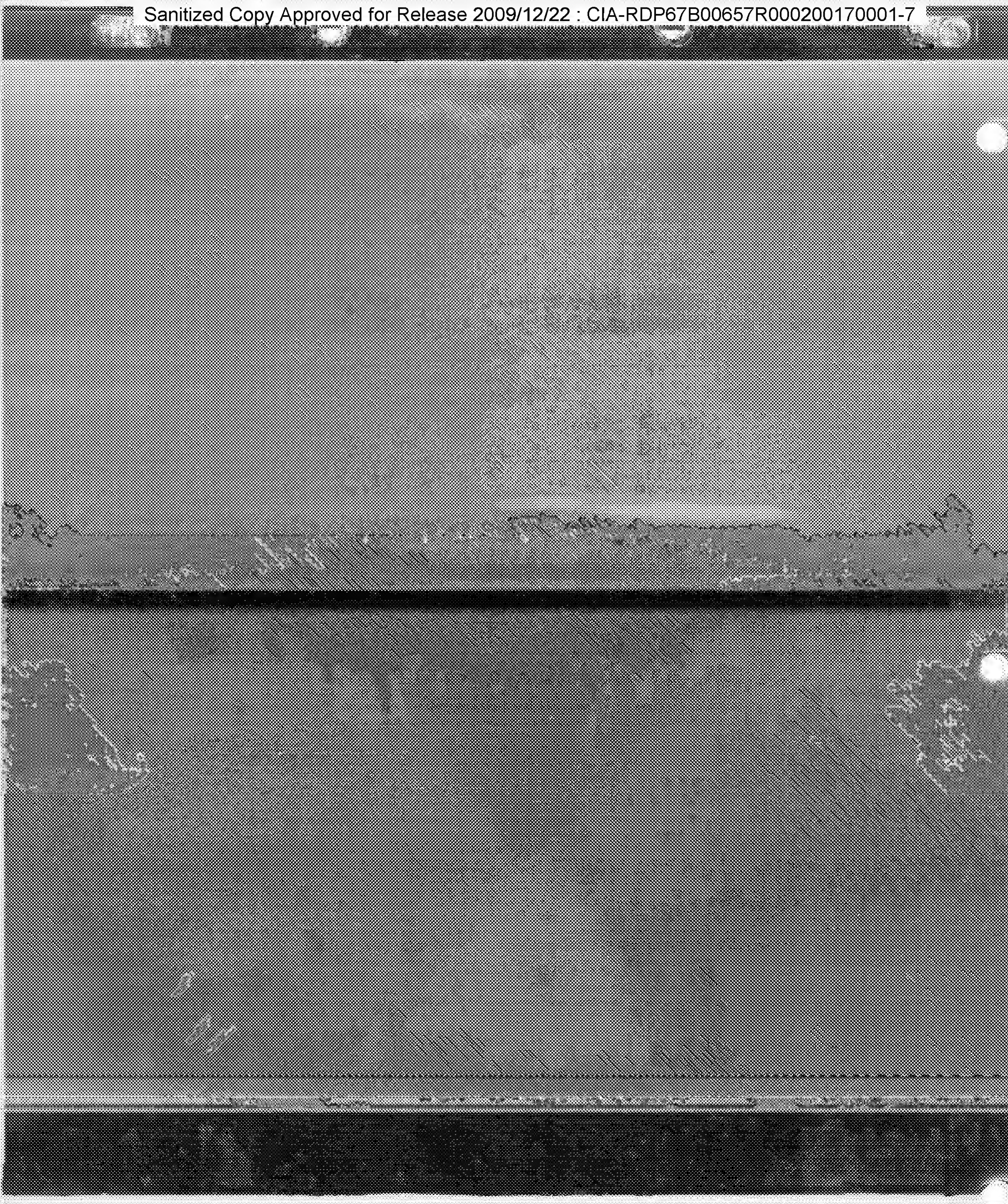

Figure 18

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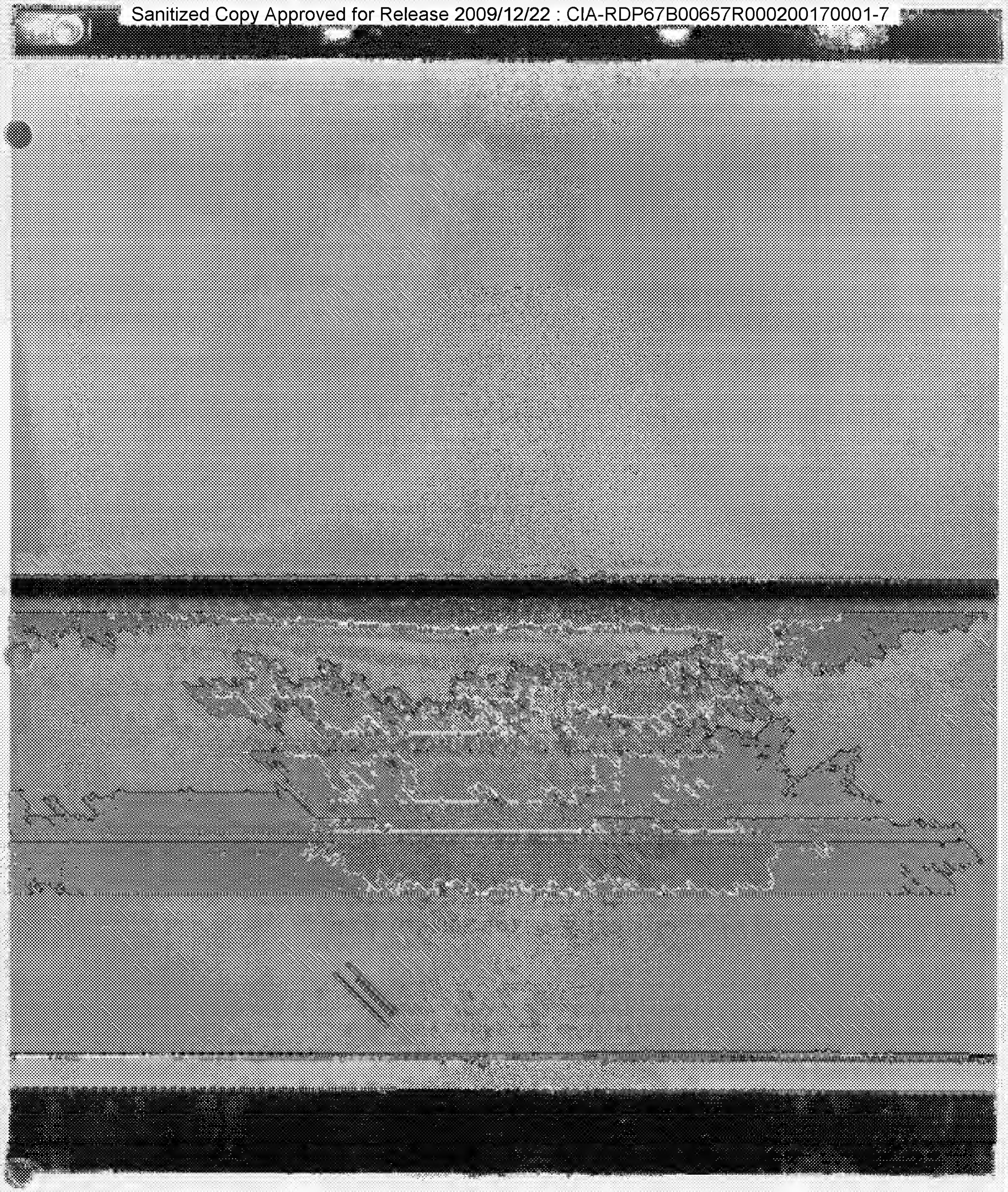

Figure 19

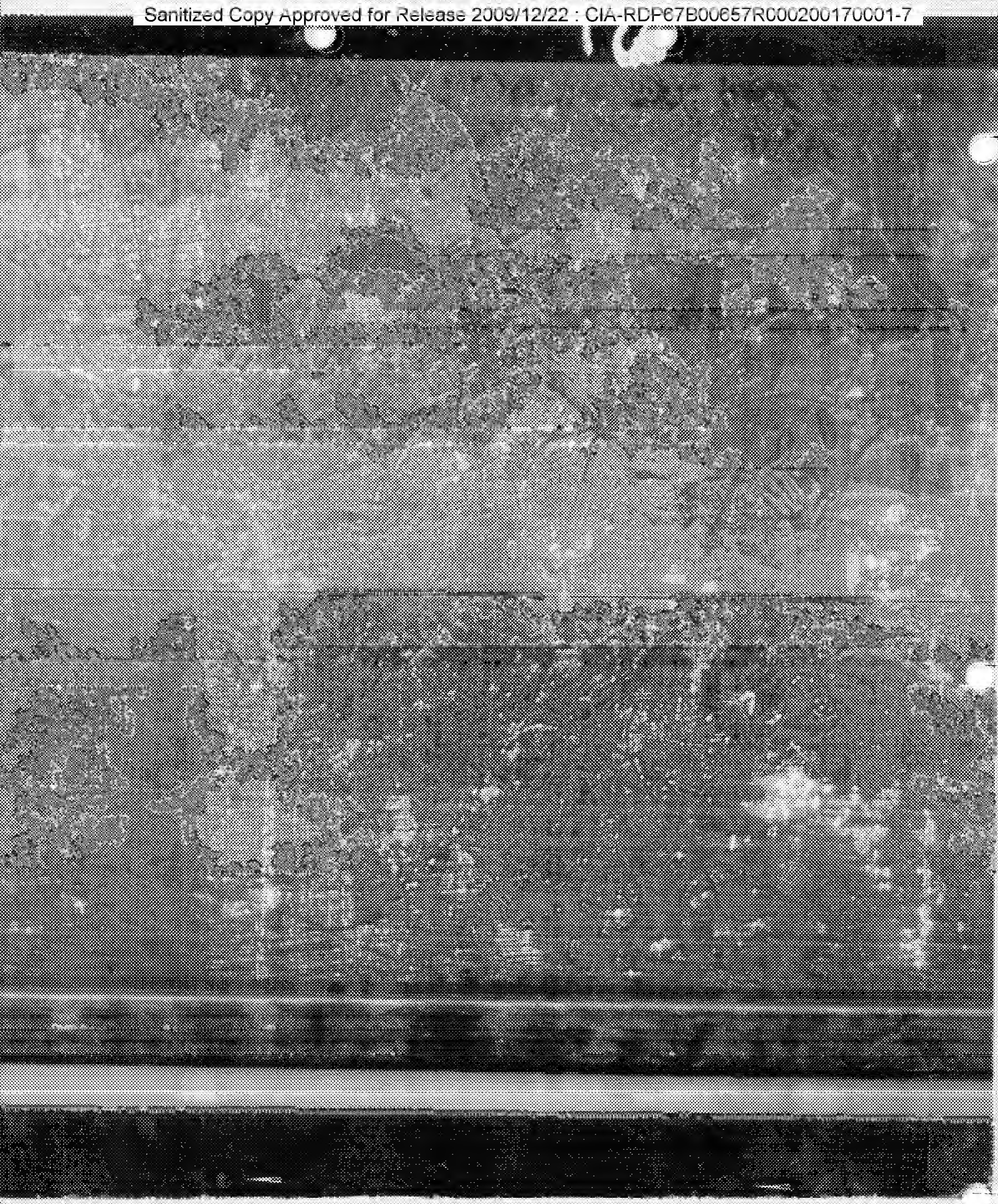

Figure 20

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OXC-4992
COPY 3 OF 3

ITEK LABORATORIES
10 Maguire Road
Lexington 73, Massachusetts

13 May 1963

STAT

Processor Progress Report from 1 April to 1 May 1963

INTRODUCTION

A proposal was prepared and delivered which outlined additional efforts on this program. The additional tasks are as follows and covered a period from May 1, 1963 thru December 31, 1963.

1. Installation of a closed loop T. V. system.
2. Field and extension of test support necessary for the F-101 flight test program.
3. The necessary work required to conduct an effective system interface engineering program.
4. The design and fabrication of an experimental processor
5. The fabrication of an optical test bench for field use.

FIELD SUPPORT

Tenative plans have been made to have the Processor ready to ship in the middle of August. The space requirements and possible layout were established for the optical equipment in the General Processor Room (19 x 19 1/2) and analytical facilities in the adjoining Operations Room (19 x 16). Environmental and equipment requirements together with power and water facilities necessary have also been supplied. Some detail lists of capital and expendable items are now available.

SPECIAL HANDLING

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PROCESSOR MODIFICATIONS

Television: The modifications to eliminate mechanical interferences were completed, but the lack of operational experience has held up 100% completion of the installation. A sliding curtain device was installed to re-close the hole in the cabinet made to accomodate the TV camera.

Drive: The new film drive is now in fabrication.

Dust Control: The various parts are being fabricated and installed.

Platen: The anti reflection coating specification was not set until information became available from the stray light problem near the end of the month. The platen is now being completed and will be installed in May.

An achromatic wedge: The optical engineering effort to lead to an achromatic prism design uncovered some problems. At the end of the month it appears that the prism is not feasable*, but the data will be summarized and discussed to see if an error or incorrect assumption has been made.

Data Optics: A new data optics device has been designed and is being fabricated. The fiber optics link has been abandoned since its flexibility to get around re-located parts is no longer necessary. The new technique uses a 1:1 magnification, which will make the data readable without magnification. It will use a flash tube as light source to eliminate image motion.

MANUAL

The operations manual was published and distributed in April. It is in two volumes, the second volume contains certain optical information and is classified.

* Further work early in May indicates that a feasable prism can be designed.

TEST PROGRAM

Report: The report covering the work done on test and simulation (Itek sup-project 9015.12) was published in April.

Cylinder Lens Ray Trace: The computer program (on an IBM 1620) for skew cylinder ray tracing did not give correct results on our system and is being corrected by the original programmer (not at Itek)

Target Testing: One of the new target patterns was checked for phase error, and found to be good to 1/5 cycle or better over its length. A new group of targets will be made using a new submaster and re-checked for phase errors.

Stray Light Investigation: The analytical work to investigate the sources of stray light was 95% completed in April. This work indicated that some previous ideas were incorrect, and showed how some of the sources of stray light can be substantially reduced or nearly eliminated. The work will be checked experimentally and improvements be made during May.

Optical Schematic: A series of diagrams giving accurate dimensions, spacing, nodal point location, beam limits, etc. are being drawn. These are based upon computed values, fabrication drawing, and processor alignment data and constitute a check on all these parameters. Certain rays are also traced through the system so as to form a basis for optical engineering calculations such as required in the anachromatic prism and stray light studies.

FLIGHT TEST

Flight film S-49 was received and processed on 5 April 1963. The flight profile called for two runs at 20,000 feet and 585 knots for a total of 15 1/4 minutes, but only about 3 minutes of the first run was recorded due to a malfunction in the recorder. During the run the CRT trace drifted partially out of the capstan slit, resulting in several clear lines on the primary record (horizontal dark lines shown in the print of Figure 1).

The primary record of S-49 showed regions of apparent RF failure with evidence of a very wide pulse. Other sections were fairly good and were correlated into maps of moderately good quality (Figure 2).

S-50 was the first 40,000' flight of the month and as indicated in Figure 3 was quite inconsistent. There were a few regions of quite good resolution (Figure 4) but suffered because of fairly weak signal strength from the terrain. A narrow band of recorded signal, which included a portion of the Naval Academy, produced a very good picture. It appeared, that platform stabilization throughout most of the run was a problem, resulting in inconsistent pictures.

S-51 (Figure 5) was much the same as S-50, and the correlated maps (Figure 6) were quite similar in resolution and contrast. However, the S-51 primary record had very poor contrast due to a loss in speed from improper processing in the new Oscar Fisher processor. At the time sensitometric data from the processor was incomplete and its performance relative to the old Houston-Fearless processor was not completely known. Processing data has since been collected, and much improved film processing has resulted.

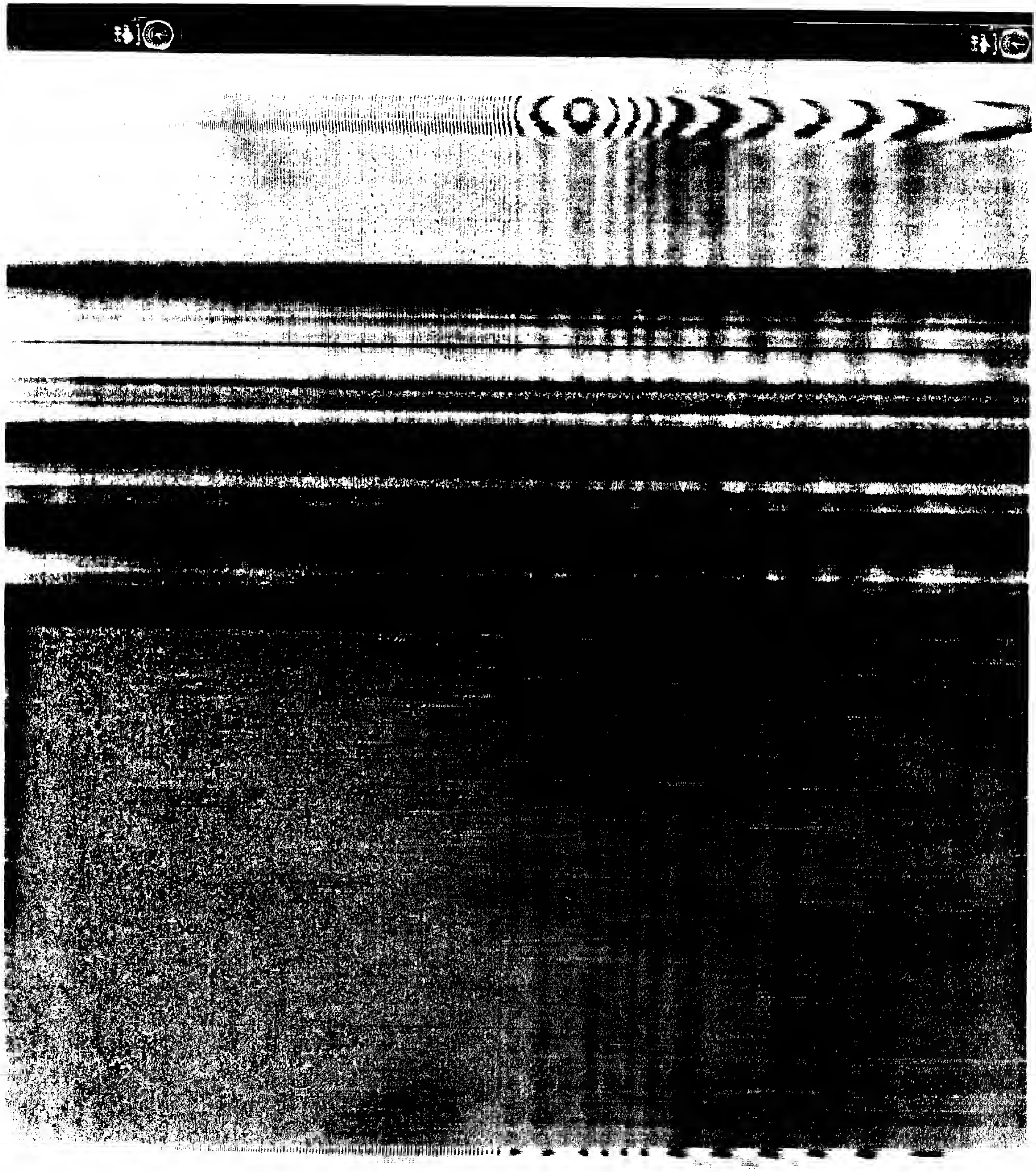
S-52 (Figure 7) was a return to 20,000 feet with excellent results. In regions where the signal history included frequencies on both sides of zero

the out-of-focus virtual image showed up as a smear which was particularly noticeable at shore lines. However, there were areas of excellent resolution and contrast (Figure 8, 9, 10). In Figure 8, for example, the runway approach lights are clearly seen, at Andrews Air Force Base, as are planes and other vehicles on the ramps. The corner reflectors near the Annapolis stadium (Figure 10) show better than 50 foot ground resolution. Reflectors spaced closer than 50 feet were not aimed properly and were not detected.

S-53 (Figure 11) was also flown at 20,000 feet with results comparable to S-52 (Figure 12, 13). Boats, roadway lights, corner reflectors, highway medians, etc. are easily seen, and there was little or no tailing off or smearing of the image at coastlines. In Figure 13 a faint ghost image of the Bay Bridge can be seen about 4 inches to the left of the real image. The two suspension towers are particularly visible. It is believed that the ghost is actually from a forward radar side-lobe, with some substantiation coming from the fact that the ghost image is at a greater range than the main range.

Sincerely,

STAT



Figure

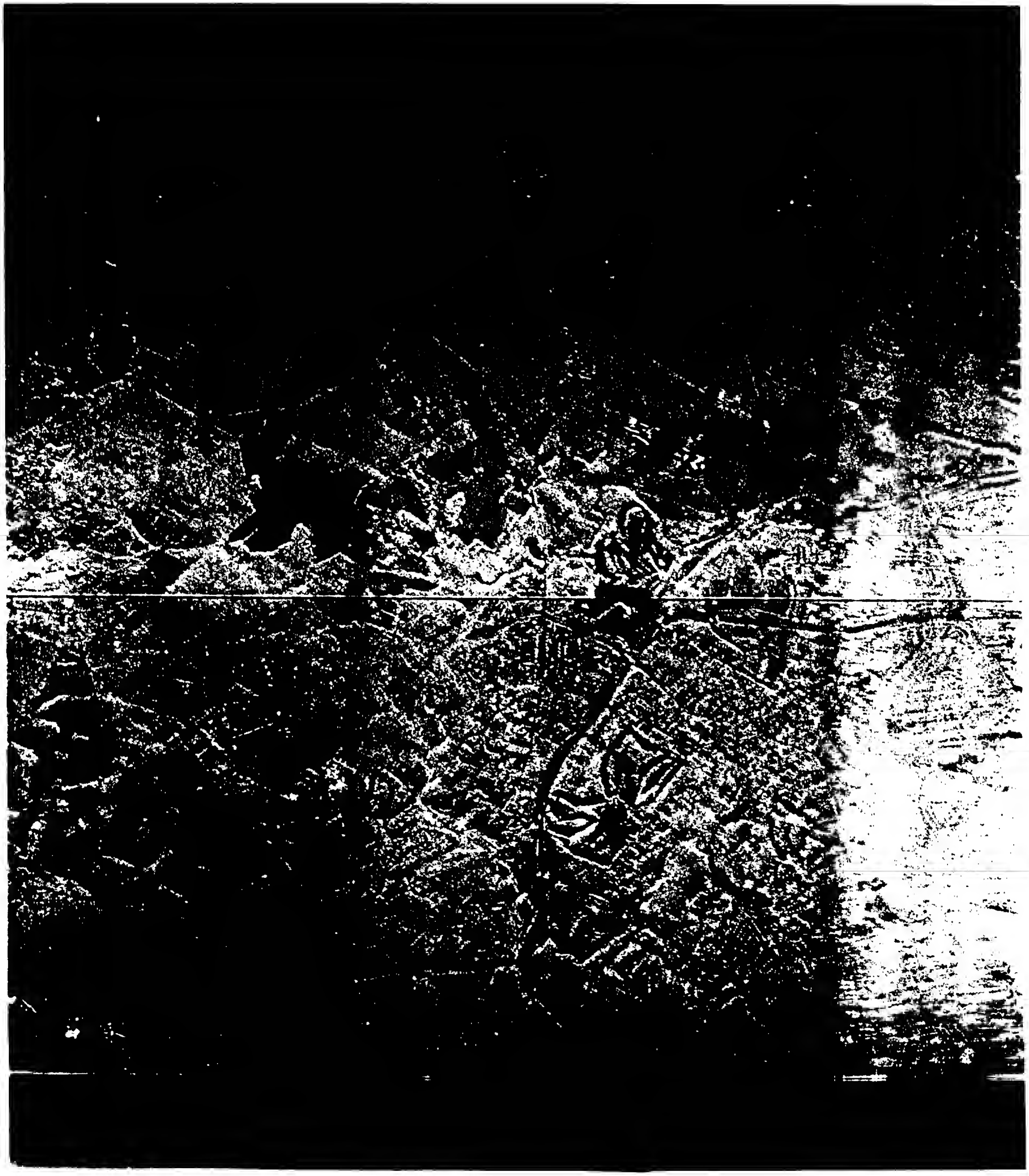


Figure 2

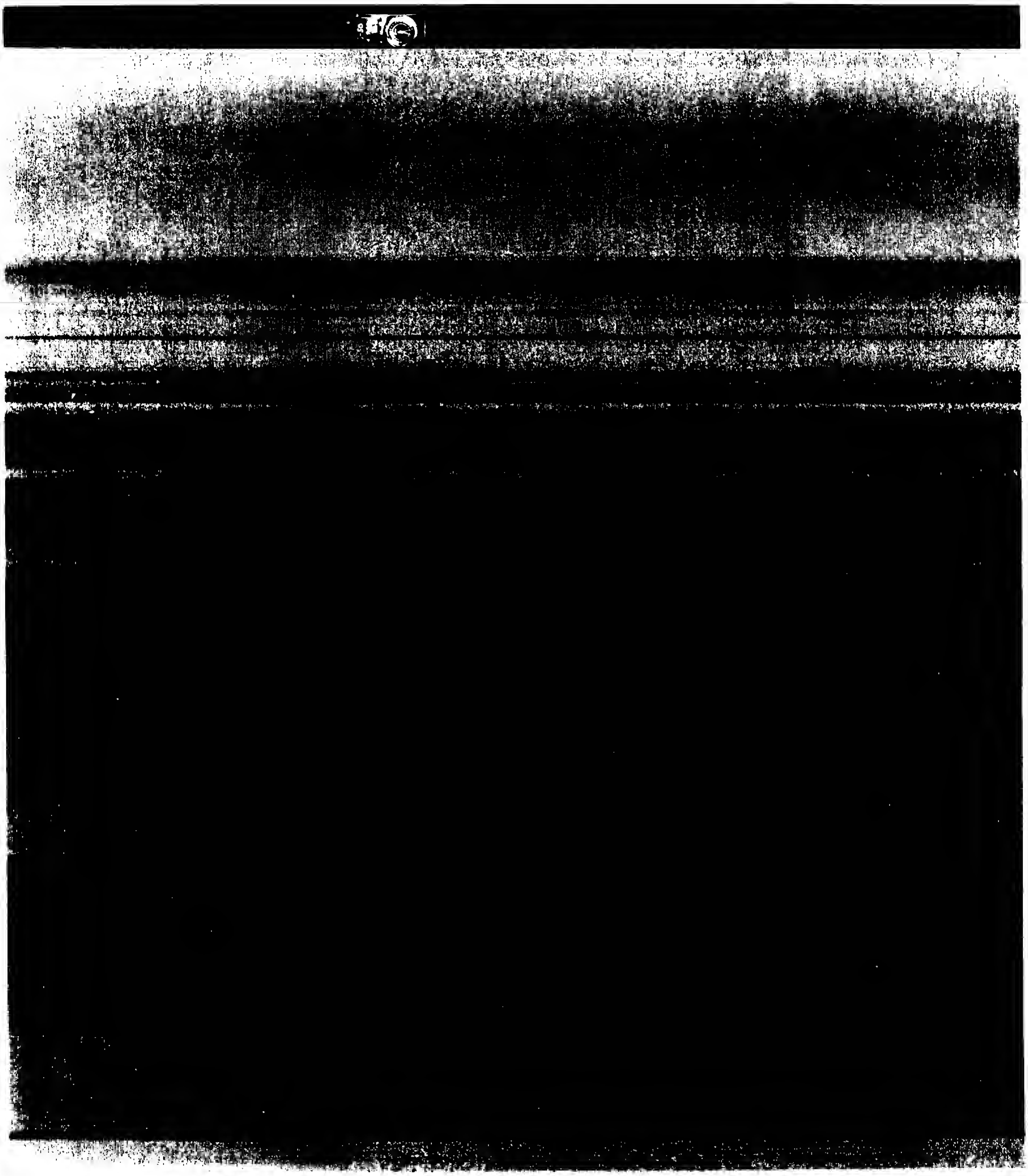


Figure 3

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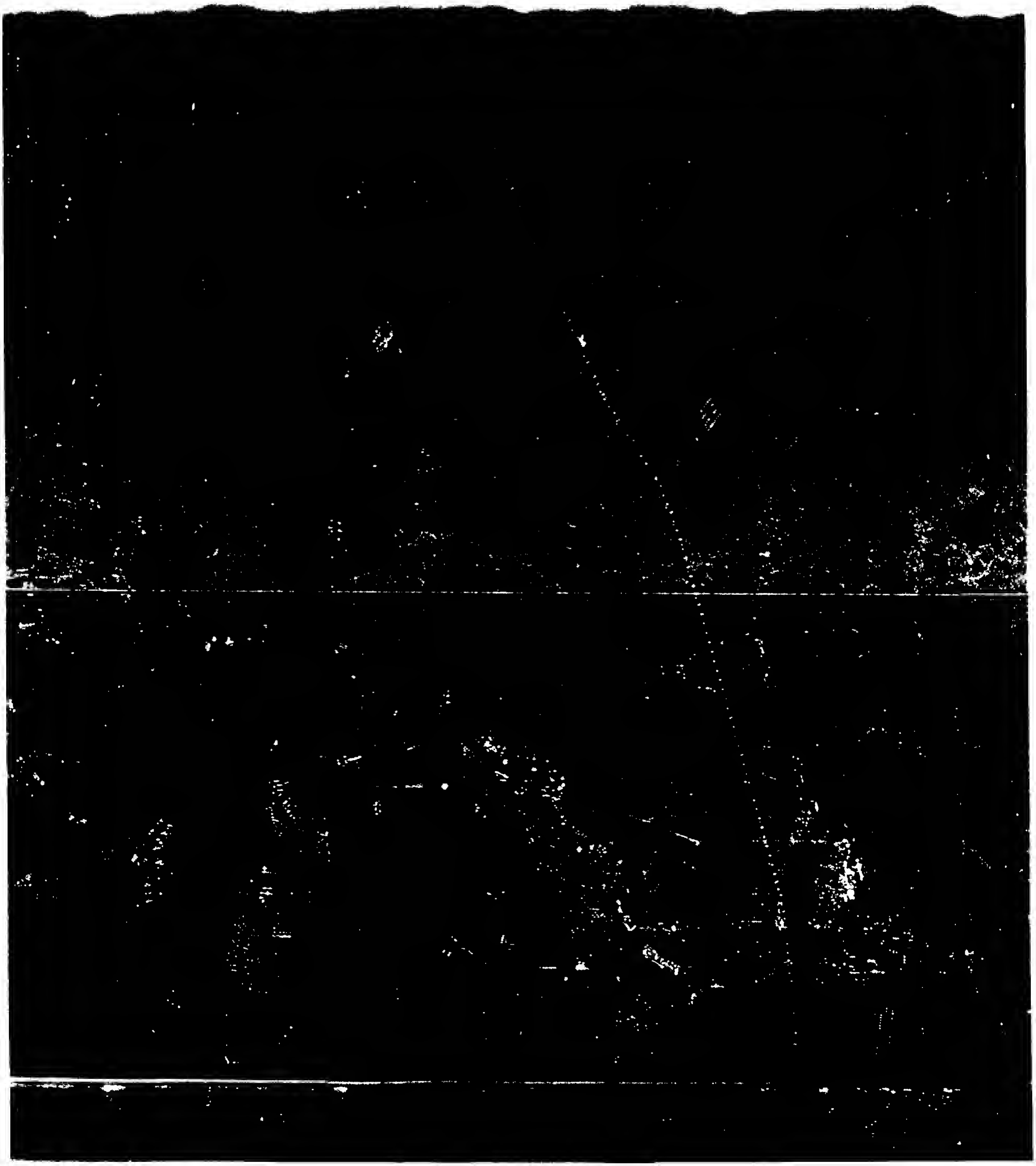
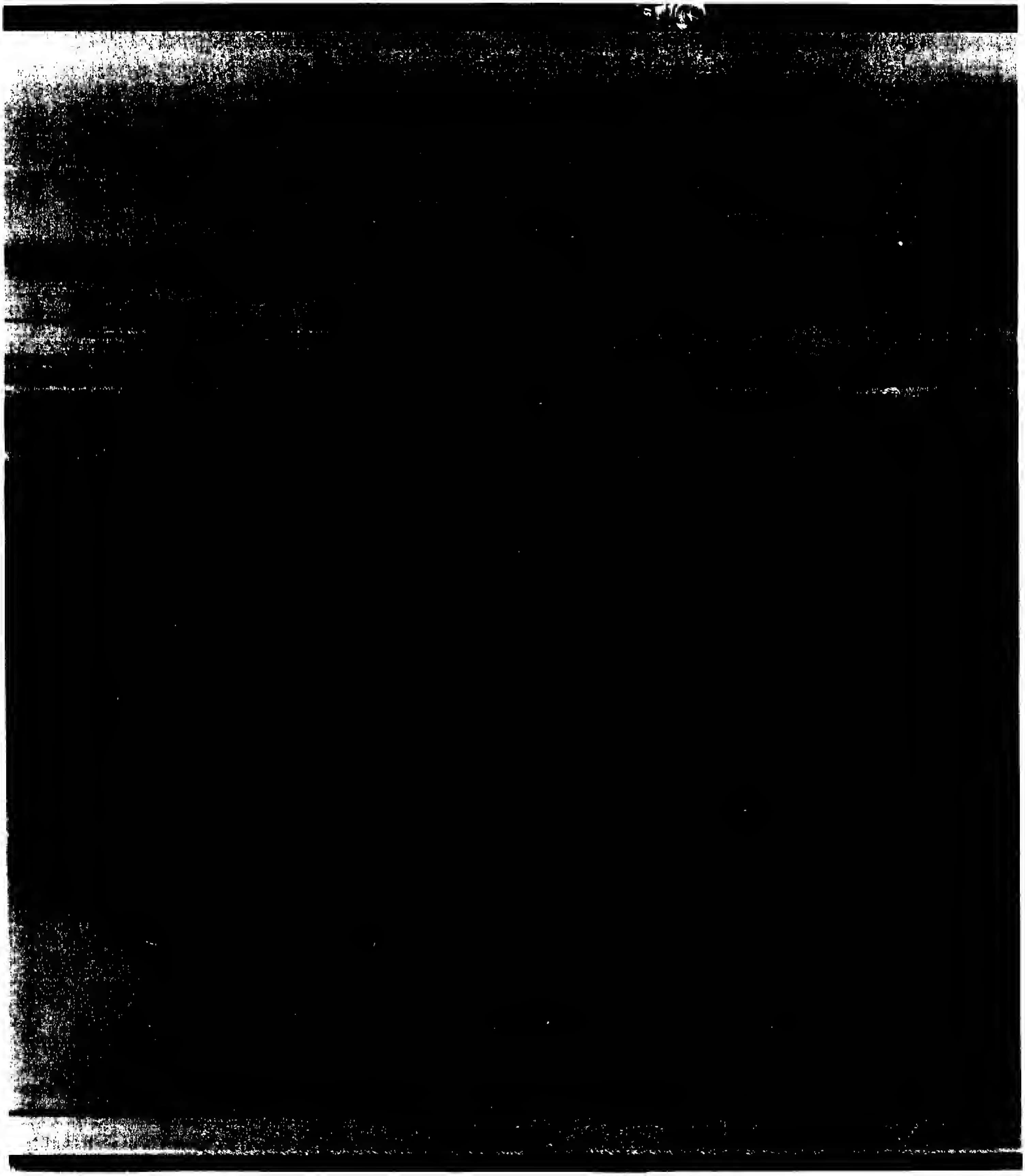


Figure 4



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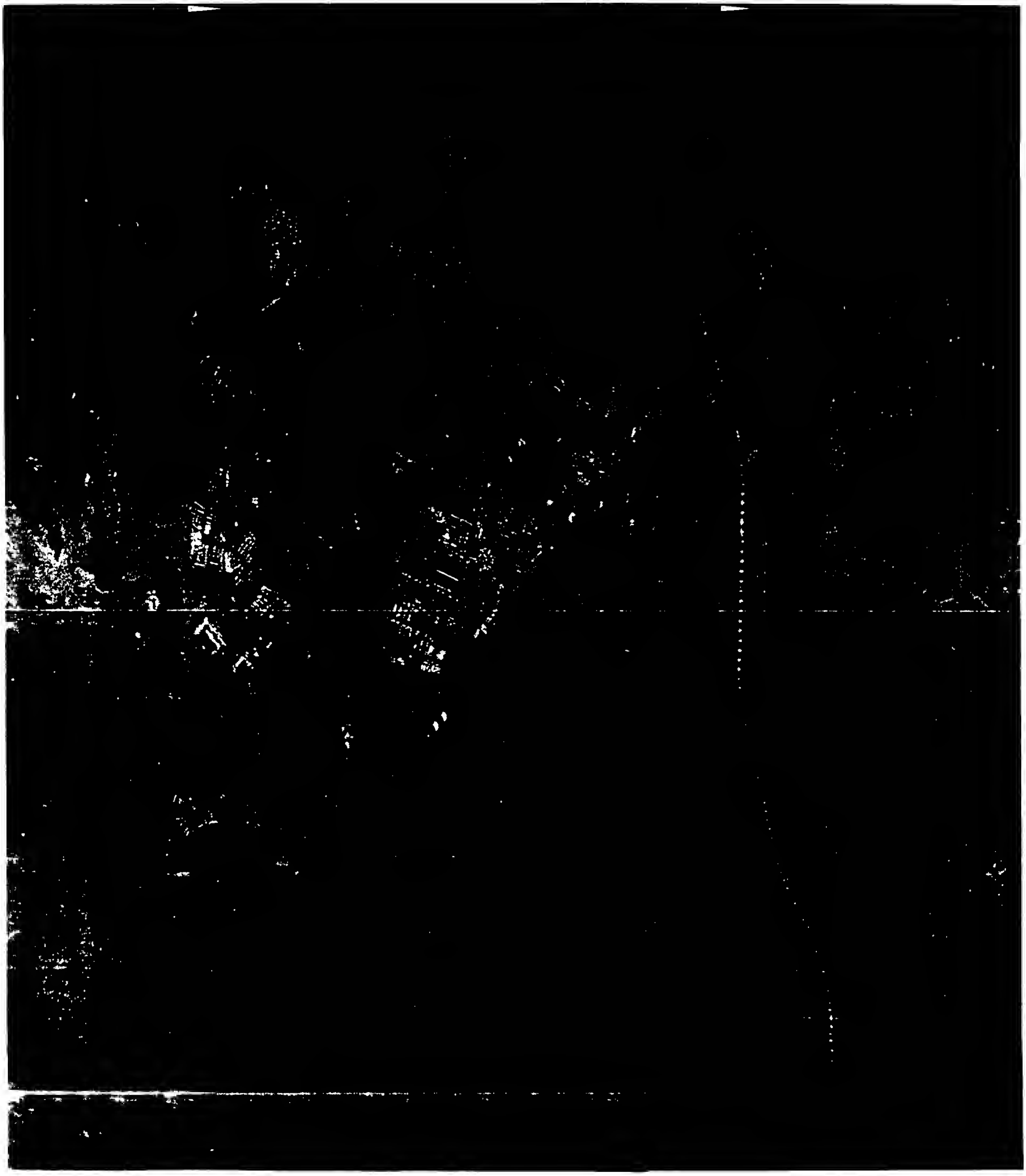

Figure 6

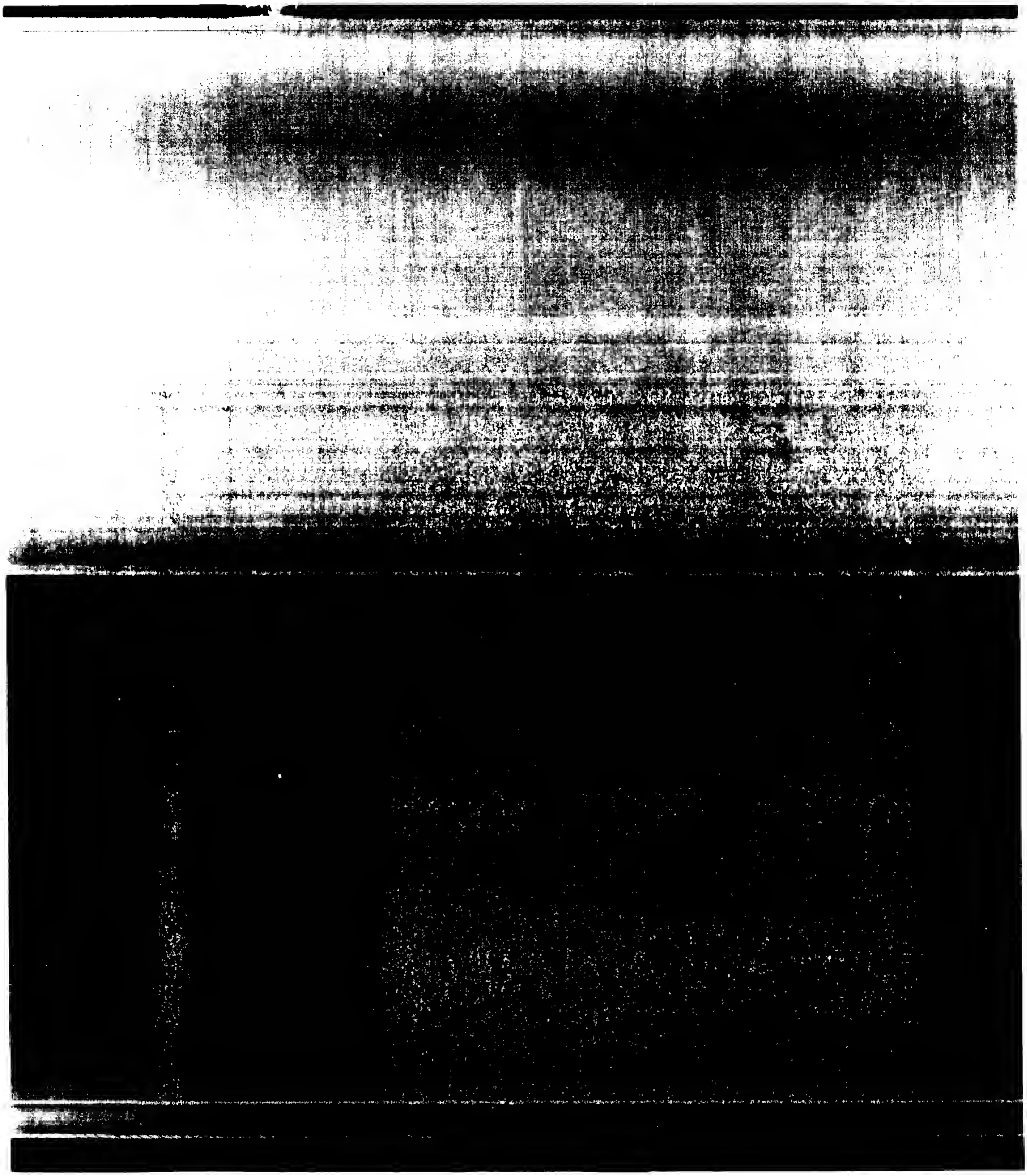

Figure 7

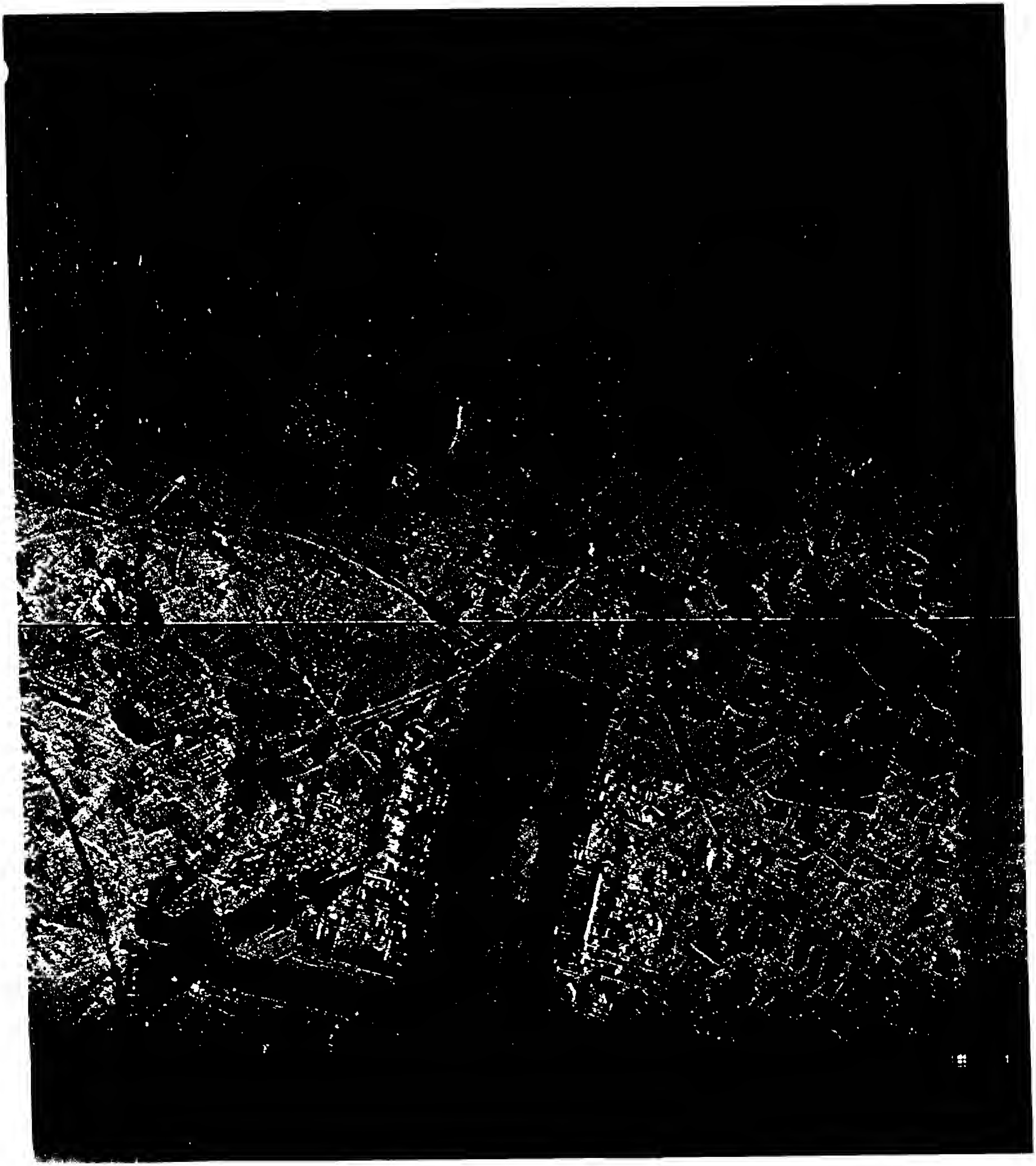

Figure 8

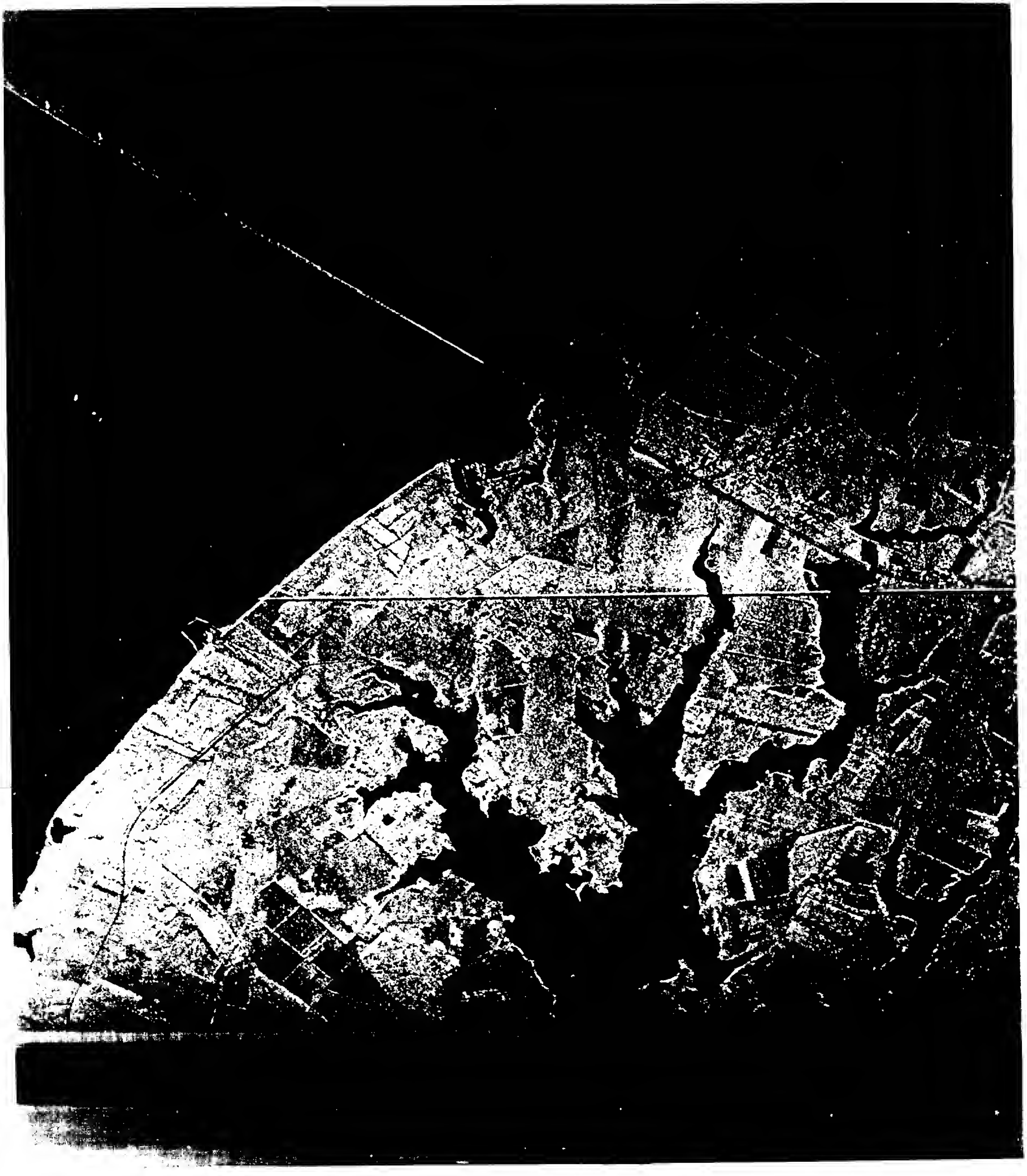

Figure [illegible]

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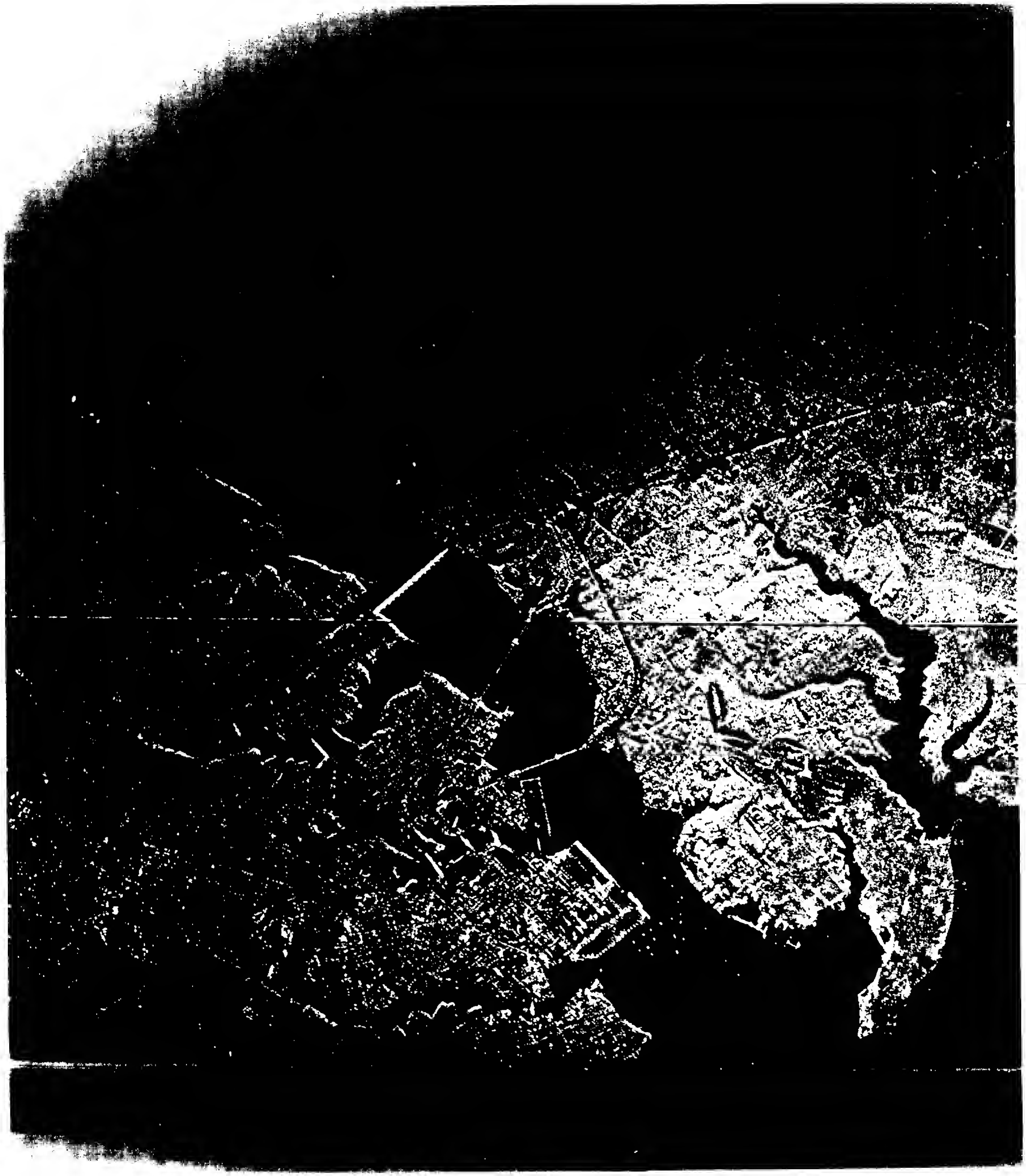

Figure 10

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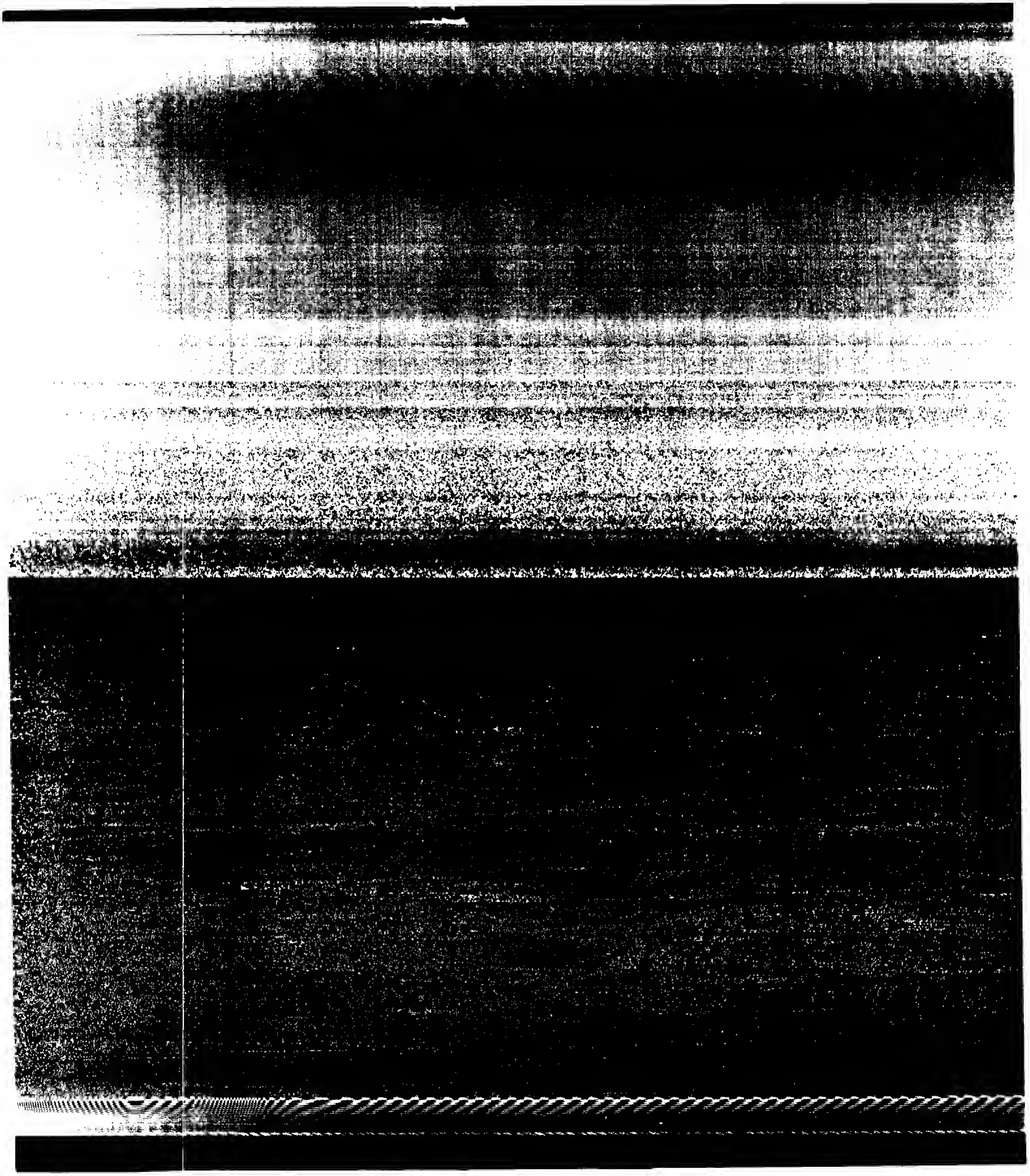

Figure 11

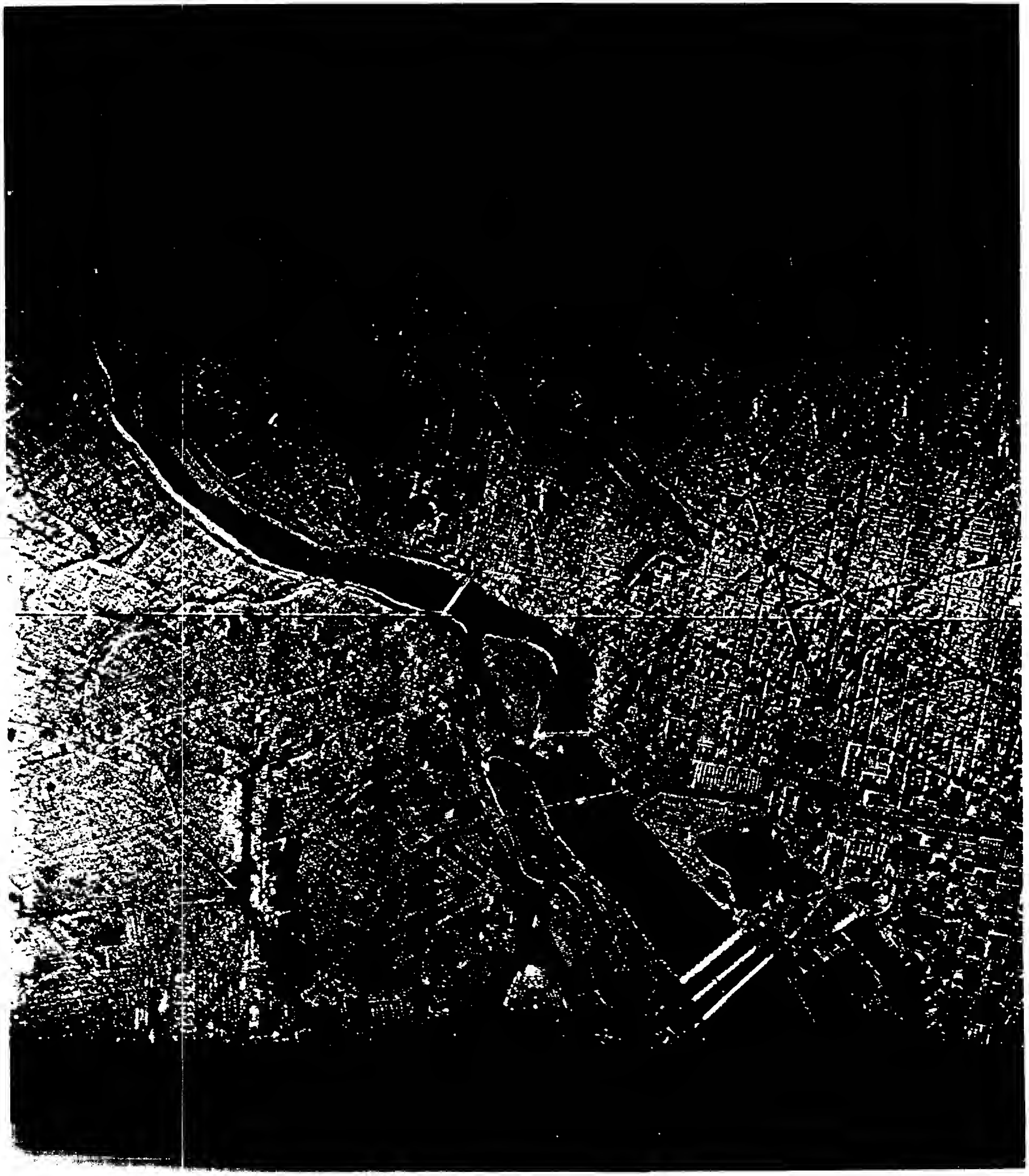

Figure 12

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Figure 13

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OXC-5208
COPY 1 OF 3

ITEK LABORATORIES
10 Maguire Road
Lexington 73, Massachusetts

18 June 1963

STAT

Processor Progress Report from 1 May to 1 June 1963

INTRODUCTION

Approval was received for the additional efforts on this program as submitted last month. This approval was not received until the end of May so for the new effort there is little to report.

Work was started on the design of the experimental processor. It was decided that the processor would be on a straight bench. This will allow for a more flexible system not limited by a bent optical path. With this set-up the input and output films will both operate in a vertical position.

PROCESSOR MODIFICATIONS

Television Monitoring: The interference between the viewing camera and the TV optics has been resolved and a stage to hold the filter and field lenses near the primary image plane will be designed in June. It will mount in the same place as the viewing camera. The reimaging lenses for the TV will remain stationary when the viewing camera is being used.

SPECIAL HANDLING

Drive: The design and drafting for the new drive system was completed in May. It will be fabricated during June. New drive wheels and some temporary improvements have made the old drive system usable for the interum.

Platen: The new platen was completed except for cementing the glass and installing into the processor. It will be installed during June.

Data Optics: The optical portions were fabricated, assembled and tested. The electronic and optical device to trigger the flash is now being made.

Anachromatic Wedge: The design of this unit has proven to be more difficult than originally anticipated, primarily due to the nature of optical glass and other transparent materials. An analysis of over 20 combinations of prism materials (including crystals, plastics, and glasses) indicated that the combination of SK 16 and SF 2 (Schott glasses) was the best. The original data indicated a prism that could not work (prism angle of about 150°), so the requirements were modified to reduce the angle. The present design has a net deviation of the optical axis of 20 (only 1° or 2° can be accomodated in the processor). The design effort is continuing.

Cone Lens: A drawing was made and fabrication was initiated on the cone lens.

Test and Simulation: No test films were run during May. The effort was placed on determining the magnification and drive ratio and equalizing them to eliminate image motion.

FLIGHT TEST

S-54 was received and processed on 2 May 1963 and was perhaps the poorest yet at 40, 000 feet. Except for a section representing about 10 seconds

of flight, and only within the near half of the near range, the signal strength was very poor.

S-55, -56 and -57 were all on the same roll of film which was processed on May 4. Because S-56 was flown at 20,000 feet and had good signal strength, it was correlated first. This flight consisted of two six minute runs, the first of which included a number of signal attenuation tests and the second was a stabilization test.

In one area of the S-56 primary film it was noted that there were two strong targets, separated by about one mile in range, which appeared to be squinted in opposite directions such that the higher frequencies of one overlapped the lower frequencies of the other. It has been suggested that this "double squint" may have been caused by aircraft pitch.

It was also noted on S-56, as well as on several other flights, that in regions of little or no apparent signal there are occasionally some very highly modulated patterns which go through zero frequency. It has been argued that in these regions of little signal strength the offset frequency may be so high that the recorder response is very low. However, if the offset is indeed high, this seems to be in contradiction with the recorded isolated targets which go through zero beat. Other theories on this subject have been advanced such as the possibility of the strong targets being detected by a side lobe of the antenna pattern. (That such a phenomen exists was demonstrated in the April 1963 report.)

During S-56, Run 2, aircraft pitch oscillations of $\pm$ 1.0 g at 0.5 cps were induced with various modes of antenna stabilization compensation being made. With the combination of the accelerometer network, doppler frequency tracker and antenna rate gyro drove the offset frequency up and down as indicated at the lower left side of Figure 3. That the pattern phase integrity was maintained fairly well is shown on the left side of Figure 4.

Although there were regions of good signal return when the accelerometer networks was removed (right side of Figure 3), pattern coherency evidently was poor as shown in the correlation of the right side of Figure 4. During this portion of the run the offset frequency was holding steady at 240 cps.

Portions of S-56 correlated quite well as shown in Figure 5.

S-57 was generally very poor, with the exception of a very few places such as shown in Figure 6. The correlated film is represented in Figure 7.

S-55, like S-57, was flown at 40,000 feet and had moderately good signal strength. (Figure 1) Because of some modifications to the correlator, the azimuth-imaging cylinders became defocussed, resulting in degraded films. During the course of realignment, it was found that the range position of the primary film was displaced by about an inch. To compensate for this requires that the wedge interference filter be moved about two inches, which is beyond the presently available adjustments. The result is that there is still some defocussing in the azimuth direction but is fairly close to being correct, as can be seen in Figure 2.

C. W. Mahon

C. W. Mahon

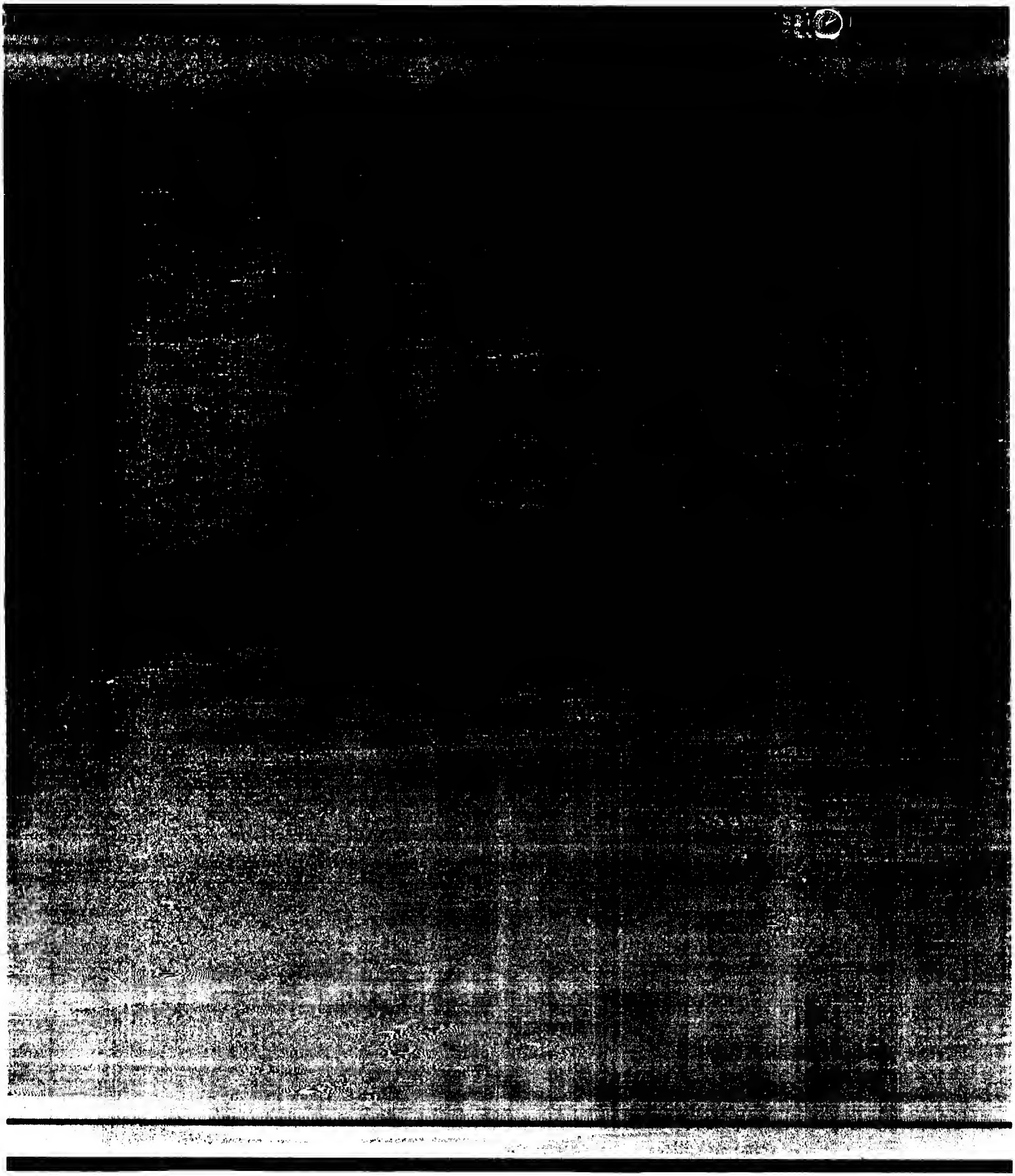

Figure 1

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Figure 2

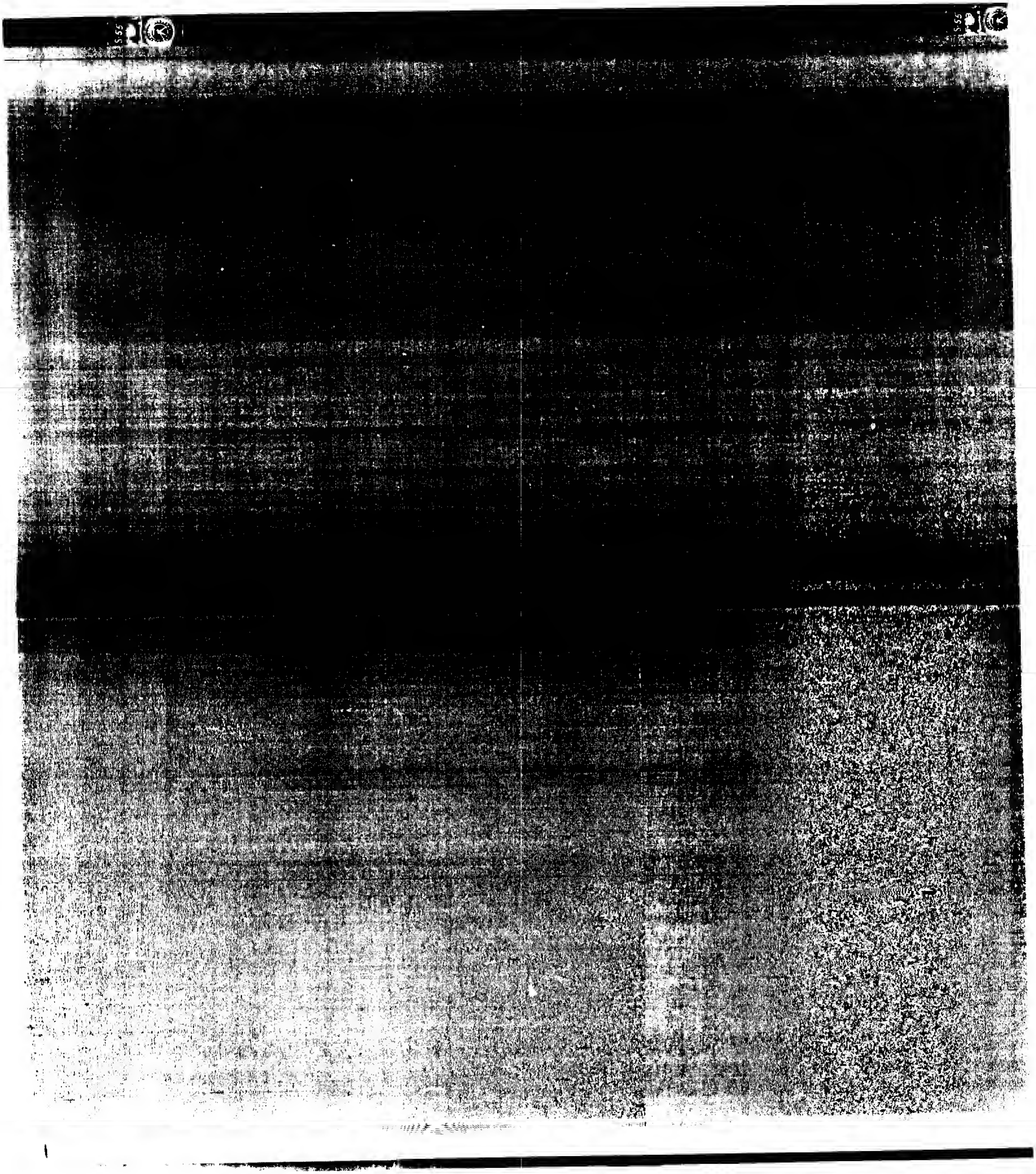

Figure 3

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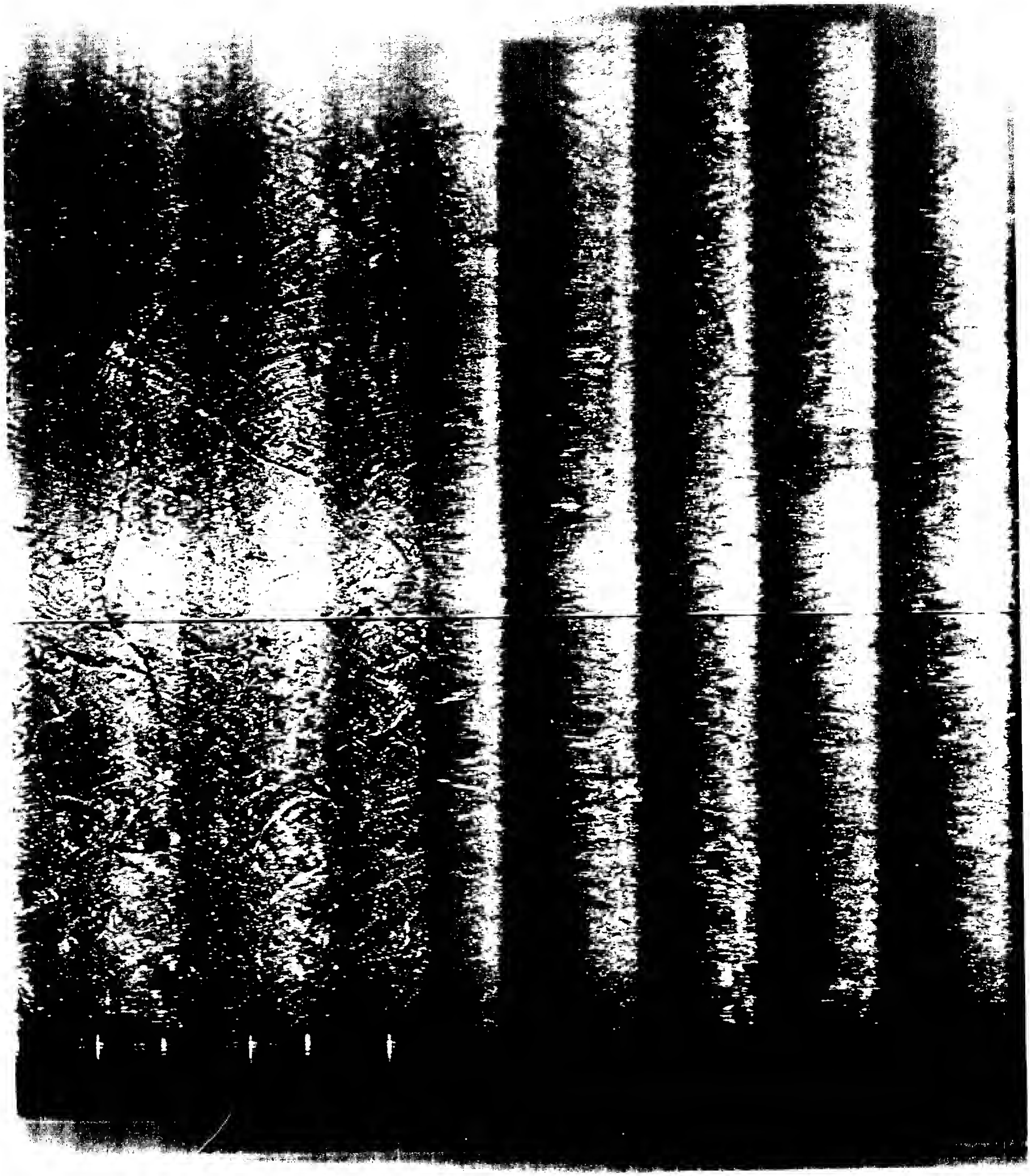

Figure 4

Figure 5

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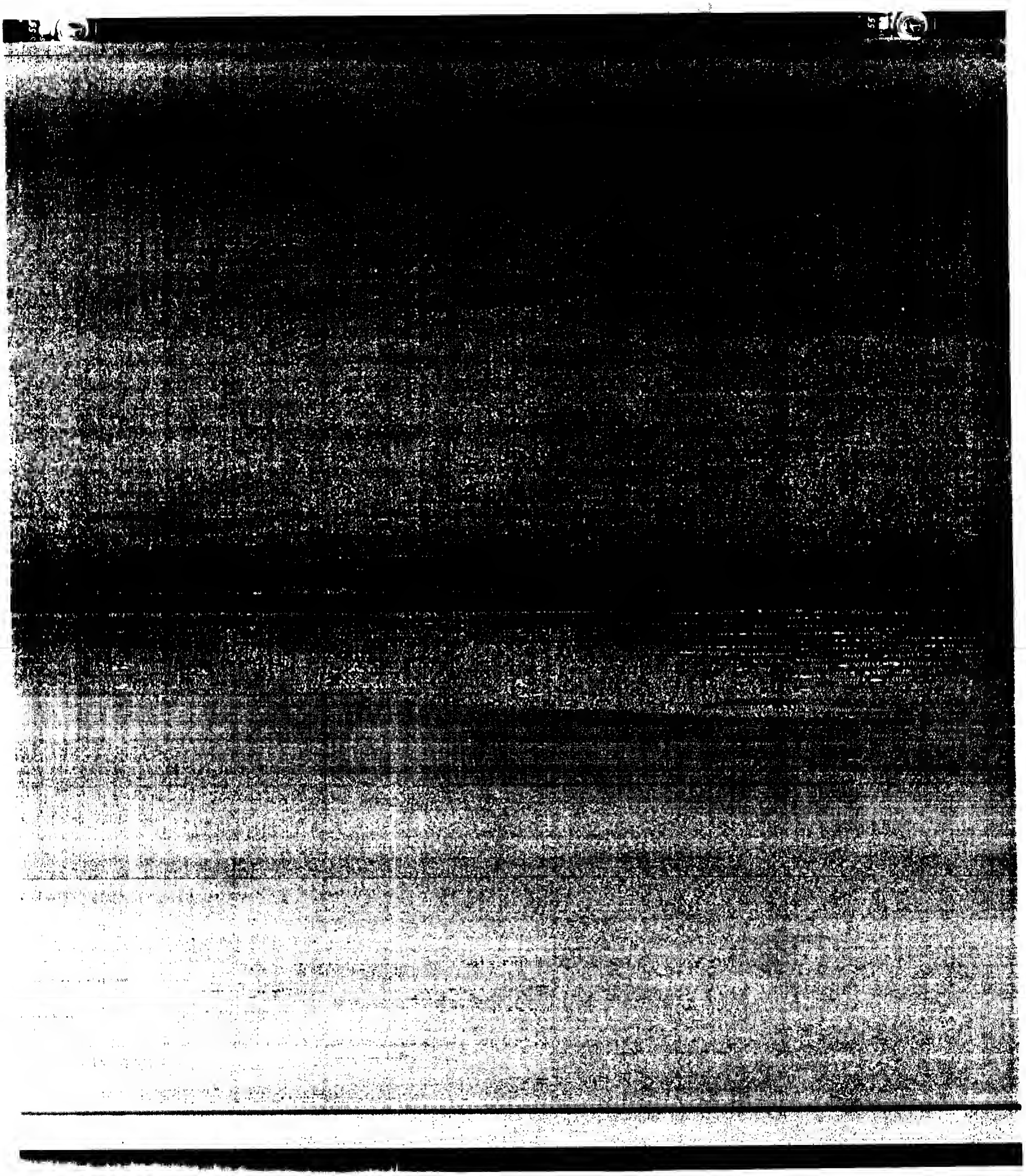

Figure 6

Figure 7

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COPY 3 OF 3

ITEK LABORATORIES
10 Maguire Road
Lexington 73, Massachusetts

23 July 1963

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Processor Progress Report from 1 June to 1 July 1963

TEST AND SIMULATION

Test film designed for the far range testing were made including pair overlaps; five overlaps; dot overlaps (.001 inch wide); and red, green, and blue pair overlap. A film with pair overlap repeated for approximately 10 feet was made to check drive uniformity was mentioned in the Flight Test section of the May report ; range position of the flight films was displaced about an inch. This required that the processor optics and drive be re-adjusted so as to preclude most test target work. However, test film T151 consisting of overlapped pairs was run with a resulting minimum separation of .0037 inches. A microdensitometer trace was run on a single ruled target image and found to have a half power width of .0026 inches as shown in Figure 1.

A special test film was made by using the recently modified Mis-omex Step and Repeat Printer as a contact printer to provide ten identical two foot lengths of a promising section of flight 62. This was run varying the squints by changing the zero order stop, making angular changes by rotating the slit and cylinders, and changing exposure by varying the input slit opening and drive speed. The results of the tests indicated that the settings were near optimum as orignially adjusted.

SPECIAL HANDLING

Investigation was started in methods of compensating lateral image spread in the correlator due to the finite bandwidth of the wedge filter.

It was found that a prism can be designed to give the required constant dispersion over the wavelength range, but that it was not possible to reduce the deviation to zero. The prism must be therefore inserted at a point where the optical system is folded so that the prism deviation can be absorbed by readjusting the mirror angle. The most practical position appears to be between the slit and collimator lens, but here the beam is diverging and the effect of a thick prism requires further checking. Below the relay lens the prism requires twice the dispersion and there is less space available.

Because of these problems, the possibility of using a reflection grating in place of the lower mirror was investigated. With present techniques it is possible to make a high frequency grating that reflects most of the incident light into a single order, thus eliminating the problems of light loss and multiple images. However, the grating frequency required in the present case is low (about 20 lines/mm) and the performance of such a grating is an unknown factor. A request to Bausch & Lomb, who have considerable experience in this field, brought the reply that they would be willing to rule such a grating on a best effort basis.

PROCESSOR MODIFICATIONS

Drive: Fabrication of the new drive system was continued during June with an expected completion date of August 8.

Platen: Due to the absence of personnel familiar with the cementing technique the platen was not installed. It is expected to be installed in the middle of July.

T.V.: The image plane optics and mount are still held up pending final location of the cylinder lens assembly.

FILM FORMAT

Some details of the position of the data from the radar unit have been incorrect. This caused a substantial error in the focal lengths of the pattern on the data film. It was found that the original design was not quite correct due to the lack of accurate data. Therefore, a new analysis was made and a new data film format was made. It is possible that this format will be changed further since it requires an assymetry in the recorder sweeps that is causing some trouble.

EXPERIMENTAL PROCESSOR

The experimental processor design was started in June. Considerable time was spent on the overall layout and requirements for the unit. Layouts were made for both a straight optical path with a vertical liquid platen and a bent optical path to accomodate a horizontal platen. On the basis of simplicity, future evolution, and recent successes with new sealing compounds and techniques, the decision was made to use a straight system.

A number of types of optical benches were investigated to see if a better bench could be obtained. It was found that all commercially available benches are too small except for one specialized granite bench. Therefore, the same design as is used on the test benches will be used.

The design and detailing of many of the parts are underway. The liquid platen design is complete.

FLIGHT TEST SUPPORT

During June ten flight films were received and processed. Most of these were quite poor due to various radar or recorder malfunctions. Of particular interest were flights S-59, S-62, S-65 and S-69.

In S-59, the overall signal strength appeared to be fairly good. Range smearing due to the pulse pedestal was evident, tapering off toward the near range side. Spurious images in the azimuth direction could be minimized by reducing the pass band of the spatial filter. These images apparently are the result of various noise frequencies which are introduced to the primary film.

S-62, in part, was correlated many times under a variety of conditions including multiple printing of the primary, rotation of the film, various input slit openings, and various range and azimuth lens focal positions. The results indicated that the settings normally used for flight film, once magnification is established, will produce a map which is about as good as can be done.

A Wratten #12 yellow filter was placed over half of the wedge filter, covering from green to red. The purpose was to block out the extraneous blue light which passed through the red end of the filter. The results showed a significant improvement in image quality in the red end.

S-65 and S-69 produced fair maps, but the primary films seemed to be somewhat degraded by less than optimum focus of the CRT or optics in the recorder.

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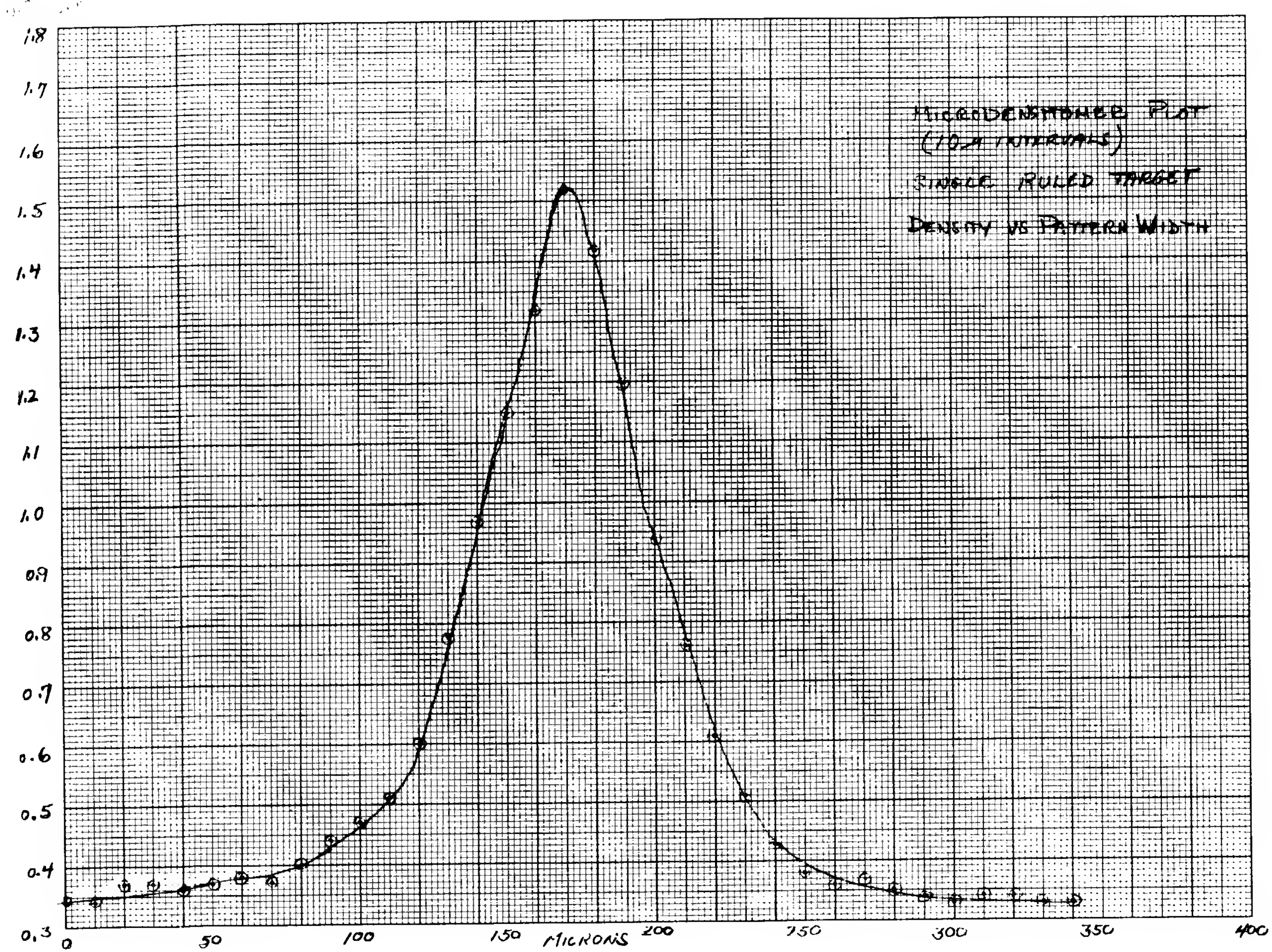

Fig. 1 Microdensitometer trace, singleruled target

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